– Draft –

Environmental Assessment for the Orbital/Sub-Orbital Program

Prepared for:

Detachment 12/RP
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14. ABSTRACT

This Environmental Assessment documents the environmental analysis of implementing the Orbital/Sub-Orbital Program (OSP), which would provide enhanced capability and flexibility to the development of space launch and target vehicles using excess Minuteman II and Peacekeeper rocket motors (including use of commercial upper stages) to meet a wide variety of mission requirements. It is expected that all OSP launches would be conducted from an existing Government range and/or commercial spaceport located at Vandenberg Air Force Base, CA; Kodiak Launch Complex, AK; Cape Canaveral Air Force Station, FL; and Wallops Flight Facility, VA.

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FINDING OF NO SIGNIFICANT IMPACT (FONSI)

ENVIRONMENTAL ASSESSMENT FOR THE ORBITAL/SUB-ORBITAL PROGRAM

Agency: United States Air Force (USAF)

Background: Pursuant to the provisions of the National Environmental Policy Act (NEPA) of 1969, Executive Order 12114, Council on Environmental Quality (CEQ) Regulations [40 Code of Federal Regulations (CFR) Parts 1500-1508], and 32 CFR Part 989, the USAF has conducted an assessment of the potential environmental consequences of implementing the proposed Orbital/Sub-Orbital Program (OSP). The assessment focused on those activities that have the potential to affect the human and natural environments.

Advances in satellite manufacturing technology have allowed the size and mass of satellites to diminish without loss of capability. As a result, the desire for reliable, low-cost spacelift systems, particularly for small and micro Research, Development, Test and Evaluation (RDT&E) satellites, has increased in recent years. However, finding shared space on some commercial or larger launch vehicles for specific orbits is not always possible or cost effective.

The Department of Defense (DOD) has a long history of using small satellites to support the testing of new components prior to incorporation into large-scale operational satellite programs. In addition, a number of small and micro RDT&E satellite programs within other US Government agencies could be supported. Low-cost target vehicles are also needed to provide realistic threat simulations for the testing of long-range ballistic missile defense systems by the DOD. Other Government missions may potentially require short-duration, sub-orbital flights for experimental purposes.

Under the OSP, the USAF is developing a new family of launch vehicles using surplus Minuteman (MM) II and Peacekeeper (PK) Inter-Continental Ballistic Missile (ICBM) rocket motors (along with commercial upper stages) to support both orbital launches of small and micro satellites, and sub-orbital-trajectory missions. The OSP will provide low-cost, reliable launch services for Government-sponsored payloads using flight-proven hardware and software currently available, with a demonstrated success record.

Consistent with the National Space Transportation Policy of 1994, OSP launches will support only US Government payloads, or those missions sponsored through US Government agencies. In addition, the US Secretary of Defense must approve each mission to ensure that program launches do not compete with, and are not detrimental to, the commercial space launch industry.

To avoid the cost of building and maintaining new launch complexes, the OSP will maximize the use of existing facilities for launch support. To satisfy various orbital inclination requirements, launch schedules, and other mission needs, spaceport locations on both East and West Coasts of the United States will be utilized.

The Environmental Assessment (EA) considers all potential impacts of the Proposed Action and the No Action Alternative. This Finding of No Significant Impact (FONSI) summarizes the results of the evaluations of the proposed activities associated with the proposed OSP.

Proposed Action and No Action Alternative: The EA documents the environmental analysis of implementing the OSP, which will provide enhanced capability and flexibility to the development of space launch and target vehicles using excess MM and PK rocket motors (including use of commercial upper stages and various subsystems) to meet a wide variety of mission requirements. It is expected that all launches will be conducted from an existing Government range and/or commercial spaceport located at Vandenberg Air Force Base (AFB), California; Kodiak Launch Complex, Alaska; Cape Canaveral Air Force Station (AFS), Florida; and Wallops Flight Facility, Virginia.

Because only a few specific missions have been identified to date for the OSP, the EA takes a programmatic approach in assuming a maximum of five or six launches per year, over a 10-year period, beginning in 2005. All five or six annual launches could occur from just one of the four ranges, or be spread across the different ranges. Vandenberg AFB and Kodiak Launch Complex will be capable of handling up to six launches per year, while Cape Canaveral AFS and Wallops Flight Facility can support up to five launches per year. For each range, applicable site modifications and construction activities (including some demolitions), rocket motor transportation, pre-flight preparations, flight activities, and post-launch operations are addressed. At each launch site, existing facilities will be used, with limited facility modifications required in most cases. Both preferred and alternate launch support facilities (if available) are considered.

In terms of orbital missions, a wide variety of small- and micro-satellites could be launched from any of the launch sites into Low Earth Orbit (LEO). Specific orbital missions identified to date for the OSP, and other representative spacecraft, are also analyzed in the EA.

Per the CEQ and USAF regulations, this EA also analyzes the No Action Alternative, which serves as the baseline from which to compare the Proposed Action. Under the No Action Alternative, the OSP would not be implemented. However, some existing missions involving the use of excess ICBM assets for target launches out of Vandenberg AFB and Kodiak Launch Complex would still be conducted, in accordance with prior NEPA analyses. In addition, use of ICBM assets for orbital launch purposes would still be considered on a case-by-case basis, following appropriate NEPA reviews.

Environmental Effects: For each of the four ranges proposed for conducting OSP launches, potential environmental effects were assessed for the following environmental resources: air quality, noise, biological resources, cultural resources (Vandenberg AFB only), health and safety, and hazardous materials and waste management. Other resource areas—including hydrology and groundwater, utilities, land use, transportation, socioeconomics, environmental justice, soil resources, visual and aesthetic resources, and cultural resources (at all other sites)—were not analyzed further because no significant impacts to these resources are anticipated as a result of implementing the Proposed Action. Potential effects on the environment from implementation of the Proposed Action are described in the following paragraphs.

- ***Air Quality.*** Because limited modifications are required at most of the ranges and facilities, construction-related impacts on air quality will be minimal. At Vandenberg AFB, proposed demolition and construction activities at some of the launch sites will generate fugitive dust from structure removal, ground disturbance, and related operations. However, no significant amounts of emissions are anticipated, and standard dust reduction measures will be implemented.

  During OSP launches at each of the four ranges, rocket motor exhaust emissions will be released into the lower atmosphere. Because the launches are infrequent, short-term events, emissions products will be rapidly diluted and dispersed by prevailing winds. No violation of air quality standards or health-based standards for non-criteria pollutants is anticipated. Also, the USAF's review of the General Conformity Rule resulted in a finding of presumed conformity with the State Implementation Plan for Vandenberg AFB. No Conformity Determination is required for the other three ranges. Overall, no significant impacts to air quality are anticipated to occur.

- ***Noise.*** Noise exposures from proposed demolition, modification, and construction activities at Vandenberg AFB are expected to be minimal, short term, and generally affecting only the areas immediately around each facility. If blasting of concrete and steel structures becomes necessary during the demolition work, much higher impulse noise levels will also be generated, but such occurrences will be rare. Any construction-related noise at the other three ranges will be minimal.

  OSP launches at each of the four ranges will generate an A-weighted Sound Exposure Level (ASEL) exceeding 120 decibels (dB) in the immediate vicinity of each launch site, to about 85 dB ASEL nearly 8 miles (13 kilometers) away. Outside range boundaries, local communities could experience launch noise levels up to 100 dB ASEL at some locations. While these noise exposure levels can be characterized as very loud, they will occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and, for public areas, will be well within Occupational Safety and Heath Administration standards. As a result, no significant impacts to the noise environment on and around each range are expected.

  Sonic booms generated during the launch vehicle's ascent are not expected to affect mainland coastal land areas at any range. However, launches from the Space Systems International (SSI) Commercial Launch Facility (CLF) or from other south Vandenberg AFB space launch complexes (SLC) could generate sonic booms over the northern Channel Islands, depending on the launch trajectory used. Resulting overpressures from SSI CLF launches could reach up to 1 pound per square foot (psf) on the islands. For launches from the SLC-4 sites, overpressures will be higher, estimated to be between 1 and 7 psf. The sonic booms will typically be audible for only a few milliseconds, and launches over the islands are expected to occur infrequently.

- ***Biological Resources.*** Because limited modifications are required at most of the ranges and facilities, construction-related impacts on biological resources will be minimal. At Vandenberg AFB, where more extensive modifications are to occur, demolition and construction-related activities will generate short periods of relatively continuous noise. In rare instances, blasting of existing structures may occur, producing very brief but high-impulse noises. Noise exposures, however, will be short-term and localized. Vegetation overgrowth around some unused launch sites at the base will require clearing, and some grading and excavation will occur, mostly in pre-disturbed areas. However, limited areas will be disturbed, and vegetated areas will be surveyed for protected and other sensitive species prior to project implementation. Some of the buildings and structures proposed for demolition and/or modification are currently used as nesting and roosting sites for various bird species, including some protected under the Migratory Bird Treaty Act. A few bat species have also been found to roost in some of the buildings. To avoid impacts to these species, surveys will be conducted several months prior to project implementation, before the start of the nesting season. Methods to discourage roosting and the initiation of nests will be implemented prior to demolition and facility modifications.

  Exposure to short-term noise from launches, from helicopter overflights at some of the ranges, and from sonic booms over the northern Channel Islands of California (for Vandenberg AFB only) could cause startle effects in protected bird species, in pinnipeds (for the West Coast sites only), and in other wildlife. However, on the basis of prior monitoring studies conducted by biologists at the four ranges, it has been determined that rocket launch activities have a negligible, short-term impact on marine mammals, most sea and shore birds, and other protected species.

  The exception in this case has been the Federally endangered California least tern, which nests and forages along the beaches and coastal dunes at Vandenberg AFB. During some prior Delta II launches at the base, a few pairs of least terns abandoned their nests. However, OSP launches will differ from the Delta II launches in that (1) the OSP launch sites are located much further away from least tern nesting habitat, (2) there will be no OSP launch vehicle overflights of the main least tern colony, (3) the proposed OSP launch vehicles will generate slightly lower noise levels and for a shorter duration, and (4) no more than two OSP launches per year will occur from those launch sites closest to nesting areas. To minimize the potential for impacts on least terns at Vandenberg AFB, the OSP will avoid night and low-light launches, to the extent possible, from the closest launch sites.

Launch emissions have the potential to acidify nearby streams, marshes, and other wetland areas at all four of the ranges. However, surface water monitoring following launches has not shown acidification to occur. In addition, acid-neutralizing minerals in the soil and/or the constant deposition of ocean salt spray will reduce the potential for acidification of surface waters. Some temporary distress to vegetation near launch sites from launch emissions can be expected, but no long-term adverse effects will occur.

The probability for an aborted launch to occur is extremely low. If an early abort were to occur, actions will immediately be taken for the recovery and cleanup of unburned liquid or solid propellants, and any other hazardous materials that had fallen on beaches or in shallow waters. Any propellants remaining in offshore waters will be subject to constant wave action and currents. Thus, water circulation will, in particular, help to prevent localized build-up of perchlorate concentrations from solid propellants, which has proven to be a slow process. As a result, no significant impacts on biological resources are expected to occur.

Through coordination and consultations with the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service, each of the four ranges has implemented various plans and measures to limit the extent and frequency of potential impacts from rocket launches, and in some cases helicopter overflights, on protected and sensitive species. In addition, monitoring of certain species is conducted on a regular basis to ensure that no long-term impacts occur.

As a result, no significant impacts on biological resources are anticipated, and no long-term adverse effects on threatened and endangered species or critical habitats are expected to occur.

- ***Cultural Resources.*** Of the four ranges evaluated, only Vandenberg AFB has the potential for impacts to cultural resources. On base, several known archaeological sites are in proximity to some of the facilities proposed for demolition, modification, and construction. However, these activities will be tailored to ensure archaeological resources are avoided. Should ground disturbance activities occur near resource sites, precautionary measures (e.g., boundary testing, on-site monitoring, and fencing around resource sites) will be implemented. Base personnel and contractors will also be informed of the sensitivity of such sites. To reduce the potential for impacts, excavation and trenching operations will be limited to previously disturbed areas as much as possible.

  Four facilities proposed for OSP use have been determined to be eligible for listing on the National Register of Historic Places for their Cold War, ICBM Program historic context. Modifications are proposed for only one of the buildings; however, a Historic American Engineering Record of the building has already been completed. In addition, the types of activities proposed to occur in these buildings will be similar to that of the earlier MM and PK ICBM support programs.

  No impacts to archaeological sites or historic buildings are expected from nominal flight activities. However, falling debris from a flight termination or other launch anomaly could strike surface or subsurface archaeological deposits, or other cultural resources. With the potential for fires to occur, firefighting activities can also damage subsurface historic and prehistoric archaeological sites. In the unlikely event that a mishap occurs, post-mishap recommendations will include post-event surveying, mapping, photography, and site recordation to determine and record the extent of the damage. These efforts will be coordinated with applicable range representatives and the California State Historic Preservation Officer.

As a result, no significant impacts to cultural resources at Vandenberg AFB are expected.

- ***Health and Safety.*** At the four ranges, all OSP activities will be accomplished in accordance with applicable Federal, state, and local health and safety standards, as well as all appropriate DOD and Agency-specific regulations. Regarding rocket motor transportation over public roads, accident rates for ongoing operations have historically been very low. To conduct OSP launches at any of the ranges, range safety officials will evacuate the launch hazard area and issue Notices to Airmen, as well as to Mariners, and the hazard areas will be determined clear of both aircraft and surface vessels before proceeding with the launch. For debris generated during each OSP launch (from liftoff through to orbit insertion), expected casualty risks for individuals on the ground will be no greater than 1 in 1,000,000, in accordance with range safety standards. By adhering to established safety standards and procedures, the level of risk to range personnel, contractors, and the general public will be minimal at all of the locations affected. Thus, no significant impacts to either occupational or public health and safety are expected to occur.

- ***Hazardous Materials and Waste Management.*** At Vandenberg AFB and Cape Canaveral AFS, some of the proposed building modifications, and related demolitions, might require surveys for asbestos, lead-based paint, and PCBs if such information is not already available. Any removal of hazardous materials from the buildings and facilities will require containerizing and proper disposal at permitted facilities.

  At Vandenberg AFB, the cumulative generation of solid waste from OSP-related demolition and construction activities, in addition to other planned demolitions, has the potential to exceed the permitted disposal tonnage on base. Coordination of implementation schedules for these projects, and appropriate tracking of disposal tonnages, will be needed to ensure that permitted disposal amounts at the Base Landfill are not exceeded.

  At all four ranges, hazardous materials will be managed in accordance with well-established policies and procedures. Hazardous wastes will be properly disposed of, in accordance with all applicable Federal, state, local, and Agency-specific regulations. Each range has in place a plan that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and waste-handling capacities will not be exceeded, and management programs will not have to change.

  Consequently, no adverse impacts from the management of hazardous materials and waste for the OSP are expected.

Because of the potential global effects of launching rockets over the oceans and through the Earth's atmosphere to orbit, the EA also considered the environmental effects on the global environment in accordance with the requirements of Executive Order 12114. Specifically, potential impacts on the upper atmosphere and stratospheric ozone layer, on marine life in the Broad Ocean Area, and on safety-related issues associated with orbital and re-entry debris were considered. These are described in the following paragraphs:

- ***Upper Atmosphere/Stratospheric Ozone Layer.*** The exhaust emissions released from OSP launch vehicles into the upper atmosphere will add to the overall global loading of chlorine and other gases that contribute to long-term ozone depletion. However, when compared to the amount of emissions released on a global scale, the flight tests will not be statistically significant in contributing to cumulative impacts on the stratospheric ozone layer. Emissions will be rapidly dispersed during the launch vehicle's ascent. Thus, no mitigating actions will be necessary.

- ***Broad Ocean Area/Marine Life.*** Sonic boom overpressures from launch vehicles could be audible to protected marine species and sea turtles underwater. An underwater acoustic pulse of 178 dB [referenced to 1 micro Pascal (μPa)] is considered the lower limit for inducing behavioral reactions in marine mammals (cetaceans), while 218 dB (referenced to 1 μPa) is considered the lower limit for inducing temporary threshold shift (TTS) in marine mammals and sea turtles. However, the resulting underwater pressures from sonic booms generated by OSP launch vehicles and sub-orbital target payloads will fall below the lower limits for inducing behavioral reactions, and well below the TTS threshold.

  For marine animals, the potential exists for direct contact or exposure to underwater shock/sound waves from the splashdown of spent rocket motors and sub-orbital target payloads. However, the likelihood for protected marine mammals or sea turtles to be located in close proximity to the impact points is extremely low, as OSP launches will occur only a few times per year, and impacts from each flight likely will not occur at the same locations.

  Though residual amounts of battery electrolytes, hydraulic fluid, and propellant materials in the spent rocket motors could lead to the contamination of seawater, the risk of marine life coming in contact with, or ingesting, toxic levels of solutions is unlikely, considering the rapid dilution of any contaminants and the rapid sinking of any contaminated components to the ocean floor.

  In summary, OSP launches will have no discernible effect on the ocean's overall physical and chemical properties. There will be minimal risk of launch vehicle components hitting or otherwise harassing marine mammals and sea turtles within the open ocean. Moreover, such activities will have no discernible effect on the biological diversity of either the pelagic or benthic marine environment. Consequently, no threatened and endangered marine mammals or sea turtles are likely to be adversely affected, nor will other biological resources within the open ocean be significantly impacted.

- ***Orbital and Re-entry Debris.*** The probability that OSP mission spacecraft in LEO will collide with medium- and large-size debris over their functional lifetimes is considered low. Moreover, OSP missions will be conducted and timed to avoid any possible impact or collision with the International Space Station and other manned missions, as part of normal operations. Accordingly, no significant impacts to the orbital debris population are expected.

  For OSP mission debris that survives atmospheric re-entry, expected casualty risks on the ground for all upper stage motors, and for all or most OSP orbital mission payloads (spacecraft), will be within DOD guidelines (expected casualty risk levels no greater than 1 in 10,000). Because of this, and the fact that no casualties from re-entry debris have been reported over the last 40 years, no significant impacts from re-entry debris are expected to occur.

Environmental Monitoring and Management Actions: Within the EA, various management controls and engineering systems for all locations affected are described. Required by Federal, state, DOD, and Agency-specific environmental and safety regulations, these measures are implemented through normal operating procedures.

Though no significant or other major impacts are expected to result from implementation of the Proposed Action, some specific environmental monitoring and management activities have been identified to minimize the level of impacts that might occur at some locations or in some environmental settings. They include avoidance of launches (whenever possible) to prevent noise impacts on pinnipeds during the pupping season, light management plans to minimize impacts on nesting sea turtles and hatchlings, and spacecraft design considerations to minimize orbital and re-entry debris. These and other measures to be implemented are summarized in Section 4.4 of the EA.

Public Review and Comment: An availability notice for public review was published in local newspapers for each program support location on or before November 3, 2005, initiating a 30-day review period that ends on December 2, 2005. Copies of the Draft EA and Draft FONSI were made available in local libraries in Alaska, California, Florida, Maryland, and Virginia. The EA and FONSI also appeared on the Space and Missile Systems Center (SMC), Los Angeles AFB web site at http://ax.losangeles.af.mil/axf, listed under "announcements."

Point of Contact: The point of contact for questions, issues, and information relevant to the EA for the OSP is Mr. Thomas Huynh, SMC/AXFV, Los Angeles AFB, California. Mr. Huynh can be reached by calling (310) 363-1541, by facsimile at (310) 363-1503, or by e-mail at Thomas.Huynh@losangeles.af.mil.

Conclusion: Based upon review of the facts and analyses contained in the EA, the SMC Environmental Protection Committee, chaired by Brigadier General William N. McCasland, has concluded that implementation of the Proposed Action will not have a significant environmental impact on the human and natural environment, either by itself or cumulatively with other projects. Accordingly, the requirements of NEPA, the CEQ Regulations, and 32 CFR Part 989 are fulfilled and an Environmental Impact Statement is not required.

Approved:

WILLIAM N. MCCASLAND Brigadier General, USAF Vice Commander	Date

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
AADC	Alaska Aerospace Development Corporation
ABRES-A	Antiballistic (Missile) Reentry System-A
ABRES-B	Antiballistic (Missile) Reentry System-B
AFB	Air Force Base
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFPD	Air Force Policy Directive
AFRL	Air Force Research Laboratory
AFS	Air Force Station
AFSPC	Air Force Space Command
AFSPCMAN	Air Force Space Command Manual
AK	Alaska
Al_2O_3	Aluminum Oxide
ANSI	American National Standards Institute
ASEL	A-weighted Sound Exposure Level
AST	Office of Commercial Space Transportation
ATDC	Advanced Technology Development Center
BOA	Broad Ocean Area
CA	California
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CCEMP	Consolidated Comprehensive Emergency Management Plan
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CLF	Commercial Launch Facility
cm	Centimeter
CNEL	Community Noise Equivalent Level
CO	Carbon Monoxide
COSMIC	Constellation Observing System for Meteorology, Ionosphere, and Climate
dB	Decibels
dBA	A-weighted Decibels
DCE	Dichloroethylene
DEP	Department of Environmental Protection
DEQ	Department of Environmental Quality
Det	Detachment
DNR	Department of Natural Resources
DOD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ETR	Extended Test Range
EWR	Eastern and Western Range
FAA	Federal Aviation Administration
FAC	Florida Administrative Code
FDE	Force Development Evaluation
ft	Feet
FL	Florida
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FY	Fiscal Year
gal	Gallon
GHz	Gigahertz
GMD	Ground-Based Midcourse Defense
GPS	Global Positioning System
GVW	Gross Vehicle Weight
HAER	Historic American Engineering Record
HAPS	Hydrazine Auxiliary Propulsion System
HCl	Hydrogen Chloride
Hz	Hertz
ICBM	Inter-Continental Ballistic Missile
ICP	Integrated Contingency Plan
IEEE	Institute of Electrical and Electronic Engineers
in	inch
IPF	Integrated Processing Facility
IRF	Integration Refurbishment Facility
IRP	Installation Restoration Program
JAWSAT	Joint Air Force Academy Weber State University Satellite
kg	Kilogram
kHz	Kilohertz
KLC	Kodiak Launch Complex
km	Kilometer
kph	Kilometers per Hour
KSC	Kennedy Space Center
L	Liter
lb	Pounds

LC	Launch Complex
LEO	Low Earth Orbit
LF	Launch Facility
LHA	Launch Hazard Area
LIDAR	Laser Radar Sensor
LMP	Light Management Plan
LOA	Letter of Authorization
LUCIP	Land Use Control Implementation Plan
m	Meter
MAB	Missile Assembly Building
MARS	Mid-Atlantic Regional Spaceport
MDA	Missile Defense Agency
mi	Mile
MM	Minuteman
MMH	Monomethyl-Hydrazine
MMPA	Marine Mammal Protection Act
MPF	Missile Processing Facility
mph	Miles per Hour
MSDS	Material Safety Data Sheet
MSS	Mobile Service Structure
MT	Missile Transporter
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NFIRE	Near Field Infrared Experiment
NiH_2	Nickel Hydrogen
nmi	Nautical Mile
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NOTU	Naval Ordnance Test Unit
NO_X	Nitrogen Oxides
NRHP	National Register of Historic Places
NSS	NASA Safety Standard
NTO	Nitrogen Tetroxide
OSHA	Occupational Safety and Health Administration
OSP	Orbital/Sub-Orbital Program
PCB	Polychlorinated biphenyl
PK	Peacekeeper
$PM_{2.5}$	Particulate Matter Less Than or Equal to 2.5 Micrometers
PM_{10}	Particulate Matter Less Than or Equal to 10 Micrometers
PMFC	Pacific Marine Fishery Council
PMRF	Pacific Missile Range Facility
PPF	Payload Processing Facility
ppm	Parts per Million
psf	Pounds per Square Foot
psi	Pounds per Square Inch
PTS	Permanent Threshold Shift
QRLV	Quick Reaction Launch Vehicle
RCC	Range Commanders Council
RCRA	Resources Conservation and Recovery Act
RDT&E	Research, Development, Test and Evaluation
ROI	Region of Influence
RSLP	Rocket System Launch Program
RSM	Range Safety Manual
RSO	Range Safety Officer
RV	Reentry Vehicle
SBCAPCD	Santa Barbara County Air Pollution Control District
SBSS	Space-Based Space Surveillance
SEL	Sound Exposure Level
SHPO	State Historic Preservation Officer
SLC	Space Launch Complex
SMC	Space and Missile Systems Center
SO_2	Sulfur Dioxide
SPCC	Spill Prevention, Control, and Countermeasures
SC	Species of Concern
SSI	Spaceport Systems International
START	Strategic Arms Reduction Treaty
SW	Space Wing
SWI	Space Wing Instruction
TCE	Trichloroethylene
TE	Transporter-Erector
THC	Toxic Hazard Corridor
TP	Test Pad
TTS	Temporary Threshold Shift
TVC	Thrust Vector Control
USAF	United States Air Force
USASMDC	US Army Space and Missile Defense Command
USC	United States Code
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
VA	Virginia
VAC	Virginia Administrative Code
VAFB	Vandenberg Air Force Base
VOC	Volatile Organic Compound
WPRFMC	Western Pacific Regional Fishery Management Council
$\mu g/m^3$	Micrograms per Cubic Meter
µPa	Micro Pascal
μPa^2s	Micro Pascal-Squared·Seconds

1.0 PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

The Space and Missile Systems Center (SMC), Detachment (Det) 12/RP (SMC/Det 12/RP)—also known as Rocket System Launch Program (RSLP)—proposes to use excess Inter-Continental Ballistic Missile (ICBM) rocket motors, including Minuteman (MM) II and Peacekeeper (PK) motors, to provide sub-orbital and space launch (orbital) vehicles to support US Government agencies. The Orbital/Sub-Orbital Program (OSP) would support the increasing number of small satellite programs within the Department of Defense (DOD) and other US Government agencies needing reliable, low-cost spacelift systems. The program would also provide low cost sub-orbital (target) vehicles to support DOD testing of long-range ballistic missile defense systems. RSLP anticipates that all launches would be from Vandenberg Air Force Base (AFB), California (CA); Kodiak Launch Complex, Kodiak, Alaska (AK); Cape Canaveral Air Force Station (AFS), Florida (FL); and Wallops Flight Facility, Virginia (VA). This Environmental Assessment (EA) documents the results of a study of the potential environmental impacts resulting from implementation of the US Air Force's (USAF's) proposed OSP.

The Purpose of an Environmental Assessment

An Environmental Assessment (EA) is prepared by a Federal agency to determine if an action it is proposing would significantly affect any portion of the environment.

The intent of an EA is to provide project planners and Federal decision-makers with relevant information on the impacts that a proposed action might have on the human and natural environments.

If the study finds no significant impacts, then the agency can record the results of that study in an EA document, and publish a Finding of No Significant Impact (FONSI). The agency can then proceed with the action. However, if the results of the EA indicate that there would be potentially significant impacts associated with the action, then the agency must proceed as follows:

- The executing agency must modify the action to reduce the environmental impact(s) to less-than-significant levels; or
- If the action cannot be feasibly mitigated to a level of no significant impact, the executing agency must then prepare and publish a detailed Environmental Impact Statement (EIS) to analyze the impacts in greater depth for the decision-makers' consideration.

In support of the SMC/Det 12/RP, the SMC Environmental Management Branch of Acquisition Civil and Environmental Engineering determined that an EA was required to assess the potential environmental impacts from the pre-flight preparations, flight activities, and post-launch operations associated with the OSP. This EA was prepared in accordance with the National Environmental Policy Act (NEPA, 1969), Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions) (Office of the President, 1979), the President's Council on Environmental Quality (CEQ) Regulations [40 Code of Federal Regulations (CFR) Parts 1500-1508] (CEQ, 2002), and 32 CFR Part 989 (*Environmental Impact Analysis Process*) (USAF, 2001a).

1.2 BACKGROUND

Established by the Secretary of Defense in 1972, the RSLP is tasked to provide Research, Development, Test and Evaluation (RDT&E) launch vehicle support to the DOD and other Government agencies using excess ICBM assets, including MM II and PK assets. Its mission includes planning; payload integration;

launch services and support; booster storage, refurbishment, transportation, and handling; and maintenance and logistics support for selected DOD RDT&E launches. Costs directly attributed to a specific launch, or program, are paid for by the user [e.g., Air Force, Army, Navy, Missile Defense Agency (MDA), National Aeronautics and Space Administration (NASA), and National Oceanic and Atmospheric Administration (NOAA)].

The USAF has developed and fielded several generations of ICBMs in support of national defense. As these systems aged, they were retired and replaced with newer systems. These ICBM components were stored for future use or disposal. Over the years, these assets have been used to support a variety of DOD programs. The smaller tactical rocket motors have been used to test missile guidance systems, to drive rocket sleds to test aircrew egress systems, and to conduct scientific research in human factors engineering or in other areas of scientific investigation. The larger ICBM-class motors have been integrated with other motors to make small sub-orbital rockets used for RDT&E activities or target vehicle systems. (Buckley et al., 1998)

Currently, the USAF has retired all MM I and II solid rocket ICBM systems, and is in the process of deactivating the fielded PK ICBM system, which will be completed in 2005. Retired missiles are dismantled and transported to Government depots for storage under controlled conditions. Several hundred motor sets are available to support DOD launch vehicle initiatives. These components are controlled and maintained by the RSLP, which has used MM assets over the last 30 years to support DOD research and testing. The USAF now has the goal of using these components to support orbital launches as well.

The US Government wants to continue fostering new commercial spacelift initiatives, and so space launch activities using surplus ICBM components would be tracked to ensure that they comply with the Commercial Space Act and do not adversely affect commercial space activities. In addition, upper stages of the OSP launch vehicles would include use of commercial products (e.g., third and/or fourth stage solid-propellant rocket motors, payload fairings, and various subsystems) manufactured by a variety of aerospace contractors. The manufacturing of these components for OSP applications would strengthen the commercial space business base. (Buckley et al., 1998)

1.3 PURPOSE OF THE PROPOSED ACTION

Under the OSP, the USAF is developing a new family of launch vehicles using surplus MM II and PK rocket motors (including commercial upper stages) to support both orbital launches of small and micro satellites, and sub-orbital-trajectory missions.[1] The OSP would provide low-cost, reliable launch services for Government-sponsored payloads using flight-proven hardware and software currently available, with a demonstrated success record.

Consistent with the National Space Transportation Policy of 1994, OSP launches would support only US Government payloads, or those missions sponsored through US Government agencies. In addition, the US Secretary of Defense must approve each mission to ensure that program launches do not compete with, and are not detrimental to, the commercial space launch industry.

To avoid the cost of building and maintaining new launch complexes, the OSP would maximize the use of existing facilities for launch support. To satisfy various orbital inclination requirements, launch

[1] An “orbital” mission is one in which the spacecraft reaches sufficient velocity to maintain a continuous orbit, in this case above the Earth. For a “sub-orbital” mission, the vehicle may briefly reach space altitudes, but rapidly returns to Earth along a parabolic trajectory hundreds or thousands of miles downrange from the launch site.

schedules, and other mission needs, spaceport locations in Alaska, California, Florida, and Virginia would be utilized.

1.4 NEED FOR THE PROPOSED ACTION

Advances in satellite manufacturing technology have allowed the size and mass of satellites to diminish without loss of capability. As a result, the desire for reliable, low-cost spacelift systems, particularly for small and micro RDT&E satellites, has increased in recent years. However, finding share space on some commercial or larger launch vehicles for specific orbits is not always possible or cost effective. Payloads are sometimes bumped several times before funding, the right launch opportunity, and readiness of the payload all come together (Bille and Kane, 2003).

The DOD has a long history of using small satellites to support the testing of new components prior to incorporation into large-scale operational satellite programs. In addition, a number of small and micro RDT&E satellite programs within NASA, the Department of Energy, and other US Government agencies could be supported. Low-cost target vehicles are also needed to provide realistic threat simulations for the testing of long-range ballistic missile defense systems by the DOD. Other Government missions may potentially require short-duration, sub-orbital flights for experimental purposes.

1.5 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This EA documents the environmental analysis of implementing the OSP, which would provide enhanced capability and flexibility to the development of space launch and target vehicles using excess MM II and PK rocket motors (including use of commercial upper stages and various subsystems) to meet a wide variety of mission requirements. It is expected that all launches would be conducted from an existing Government range (Western Range or Eastern Range) and/or commercial spaceport located at Vandenberg AFB, CA; Kodiak Launch Complex, AK; Cape Canaveral AFS, FL; and Wallops Flight Facility, VA. Figure 1-1 shows the geographic locations of these launch sites.

Because only a small number of specific missions have been identified to date for the OSP, this EA takes a programmatic approach in assuming a maximum of five or six launches per year, over a 10-year period, beginning in 2005. All five or six annual launches could occur from just one of the four ranges, or be spread across the different ranges. For each range, site modifications and construction, rocket motor transportation, pre-flight preparations, flight activities, and post-launch operations are addressed. In each case, existing buildings and facilities would be used, with limited facility modifications required in most cases. Both preferred and alternate launch support facilities (if available) are considered.

In analyzing the potential environmental impacts that might occur at buildings and facilities, specific plans for their operation and any applicable site modifications were not always available because of the programmatic nature of the OSP and the future missions it would support. As a result, a complete analysis of potential impacts for some resources was not always possible during this EA process. For example, a thorough assessment of potential impacts on archaeological resources could not be accomplished at some locations because construction and engineering design plans, delineating where excavation and grading might occur, have not yet been developed. Thus, these additional environmental reviews would be completed, when necessary, prior to implementation of the Proposed Action at each building or facility selected. In the case of Vandenberg AFB and Cape Canaveral AFS, the USAF Form 813, *Request for Environmental Impact Analysis*, would be used (USAF, 2001a). If additional environmental reviews become necessary at Kodiak Launch Complex or at Wallops Flight Facility, a similar process would be applied. Each range would determine the appropriate level of environmental review and analysis that is needed.

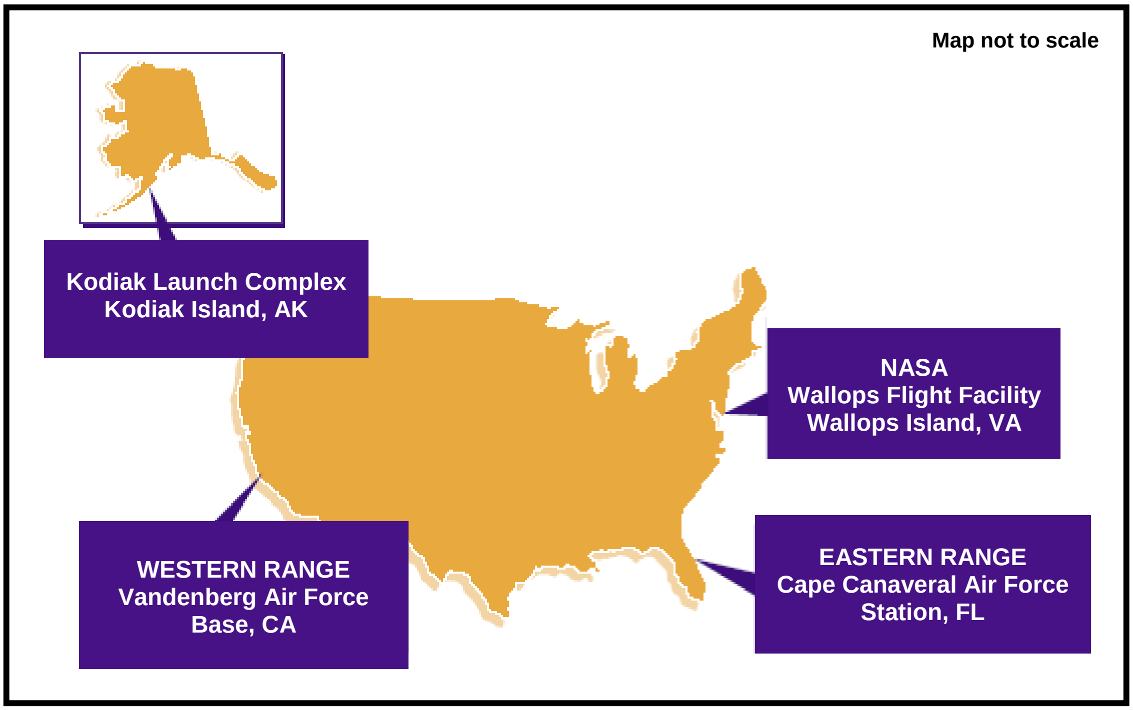


Figure 1-1. Proposed Launch Locations for the Orbital/Sub-Orbital Program

In terms of orbital missions, a wide variety of small and micro-satellites could be launched from any of the launch sites into Low Earth Orbit (LEO). Specific orbital missions identified to date for the OSP, and other representative spacecraft, are also analyzed in this EA.

As per the CEQ and USAF regulations [40 CFR 1502.14(d) and 32 CFR 989.8(d), respectively], this EA also analyzes the No Action Alternative, which serves as the baseline from which to compare the Proposed Action. Under the No Action Alternative, the OSP would not be implemented. However, some existing missions involving the use of excess ICBM assets for target launches out of Vandenberg AFB and Kodiak Launch Complex would still be conducted, in accordance with prior NEPA analyses. In addition, use of ICBM assets for orbital launch purposes would still be considered on a case-by-case basis, following appropriate NEPA reviews.

1.6 RELATED ENVIRONMENTAL DOCUMENTATION

The Acquisition Civil and Environmental Engineering Branch, Space and Missile Systems Center, Los Angeles Air Force Base, relied heavily upon several existing NEPA documents in preparing this EA. These documents are listed below and cited in the EA where applicable. Those documents that have been completed can also be accessed on the Internet at the following Los Angeles AFB web site: http://ax.losangeles.af.mil/axf.

- Cape Canaveral Air Force Station and Spaceport Florida Authority. 1994. *Finding of No Significant Impact and Environmental Assessment of the Proposed Spaceport Florida Authority Commercial Launch Program at Launch Complex-46 at the Cape Canaveral Air Station, Florida*. October.

- Federal Aviation Administration/Associate Administrator for Commercial Space Transportation. 1996. *Environmental Assessment of the Kodiak Launch Complex, Kodiak Island, Alaska*. June.

- National Aeronautics and Space Administration. 1997. *Final Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center, Wallops Flight Facility, Wallops Island, Virginia*. October.

- National Aeronautics and Space Administration. 2001. *Environmental Assessment for the Advanced Technology Development Center at the Cape Canaveral Air Force Station Launch Complex 20, Florida*. May.

- National Aeronautics and Space Administration. 2002. *Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Air Force Station, Florida, and Vandenberg Air Force Base, California*. June.

- National Aeronautics and Space Administration. 2003. *Final Environmental Assessment for a Payload Processing Facility, National Aeronautics and Space Administration Goddard Space Flight Center, Wallops Flight Facility, Virginia*. January.

- National Aeronautics and Space Administration. 2003. *Final Environmental Assessment for AQM-37 Operations at the National Aeronautics and Space Administration Goddard Space Flight Center, Wallops Flight Facility, Wallops Island, Virginia*. June.

- National Aeronautics and Space Administration. 2005. *Final Site-Wide Environmental Assessment for Wallops Flight Facility, Virginia*. January.

- US Army Space and Missile Defense Command. 2003. *Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR) Final Environmental Impact Statement*. July.

- US Department of the Air Force. 1995. *Environmental Assessment for the California Spaceport, Vandenberg Air Force Base, California*. February.

- US Department of the Air Force. 1997. *Final Theater Ballistic Targets Programmatic Environmental Assessment, Vandenberg Air Force Base, California*. December.

- US Department of the Air Force. 1998. *Final Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program*. April.

- US Department of the Air Force. 2000. *Final Supplemental Environmental Impact Statement for the Evolved Expendable Launch Vehicle Program*. March.

- US Department of the Air Force. 2004. *Final Environmental Assessment for Minuteman III Modification*. December.

- US Department of the Air Force. 2005. *Final Draft Programmatic Environmental Assessment for Demolition and Abandonment of Atlas and Titan Facilities, Vandenberg Air Force Base, California*. June.

1.7 DECISIONS TO BE MADE

Supported by the information and environmental impact analysis presented in this EA, the USAF will decide on whether to proceed in implementing the proposed OSP launches, or to select the No Action

Alternative. If the OSP is allowed to proceed, decisions on how to implement the program—in terms of which ranges and facilities to use, launch vehicle configurations, launch rates, etc.—will depend on individual mission needs, the availability of range assets, and other logistical considerations and constraints.

1.8 INTERAGENCY COORDINATION AND CONSULTATIONS

Ongoing interagency coordination is integral to the preparation of this EA. The USAF has closely coordinated with the MDA, NASA, and Federal Aviation Administration (FAA)/Office of Commercial Space Transportation (AST) as cooperating agencies during the analysis—the MDA for their involvement in supporting the analysis of the Near Field Infrared Experiment (NFIRE) mission, NASA for the use of Wallops Flight Facility as a proposed launch site for the OSP and as a potential user of the program, and the FAA/AST for their launch and launch site operator licensing responsibilities.

During public review of the Draft EA, regulatory agencies, including the appropriate field offices of the US Fish and Wildlife Service (USFWS) and the NOAA Fisheries Service, the Coastal Commission within each affected state, and the California State Historic Preservation Officer (SHPO), will be given the opportunity to comment on the document. A list of those agencies, organizations, and officials that were sent a copy of the Draft EA/FONSI is provided in Chapter 8.0. If the USAF decides to finalize the EA, agency comments received during the public review process will be incorporated into the Final EA, where appropriate, and the correspondence attached as an appendix. Additional coordination and consultations with the agencies will be conducted, as necessary.

1.9 PUBLIC NOTIFICATION AND REVIEW

As per the CEQ (2002) and USAF (2001a) regulations for implementing NEPA, the USAF is soliciting comments on this EA from interested and affected parties. A Notice of Availability for this Draft EA, and the enclosed Draft FONSI, has been published in local newspapers for each location involved. Copies of the Draft EA and Draft FONSI are being placed in local libraries or offices, in addition to being available over the Internet at http://ax.losangeles.af.mil/axf. This information is being provided in all regions affected, including Alaska, California, Florida, and Virginia.

Following the 30-day public review period (as specified in the newspaper notices), the USAF will decide whether to finalize the EA and sign the FONSI, which would allow the proposed OSP launches to proceed. If the decision is to finalize the document, the USAF will, in developing the Final EA and FONSI, take into consideration those public and agency comments received. Both the comments and discussions on how they were resolved will be included in the Final EA.

Once completed, copies of the Final EA and FONSI will be made available to those organizations and individuals who provided comments on the Draft EA/FONSI, or who specifically requested a copy of the final document. The Final EA and FONSI will also be made available over the Internet.

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

Two actions are assessed in this EA—the Proposed Action and the No Action Alternative. Section 2.1 provides a description of the MM and PK launch vehicles, spacecraft and orbital missions, targets and other sub-orbital missions, launch sites, and flight scenarios. Section 2.2 provides a description of the No Action Alternative. Alternatives to the Proposed Action that were considered and eliminated from further study are discussed in Section 2.3. Lastly, a summary comparison of the environmental impacts associated with the Proposed Action and the No Action Alternative is presented in Section 2.4.

2.1 PROPOSED ACTION

2.1.1 LAUNCH VEHICLES

For the OSP, two types of launch vehicles would be used: those derived from MM systems and those derived from PK systems. Each of these would utilize excess ICBM rocket motors for the lower two or three stages, with upper stages consisting of other ICBM motors and/or commercially available motors. A description of each of these types of launch vehicles is presented in the sections that follow.

2.1.1.1 Minuteman-Derived Launch Vehicles

The MM-derived launch vehicles would consist of the following major vehicle sections: a 3- or 4-stage solid-propellant booster; a liquid-propellant auxiliary propulsion system (optional); a Guidance Control Assembly Module or Avionics Assembly; and a payload assembly for the target vehicle(s)/experimental package(s) (sub-orbital missions) or spacecraft (orbital missions), including a protective shroud for the payload (optional for target vehicles). Other separation modules or vehicle adapter sections may also be used. Depending on the number of motor stages, payload, and other mission requirements, the overall vehicle length would be approximately 60 to 63 feet (ft) [18.2 to 19.2 meters (m)], with a maximum diameter of 5.5 ft (1.7 m) and an approximate weight of 80,000 pounds (lb) [36,000 kilograms (kg)], not including mass of the payload. A diagram showing examples of MM-derived target and space launch vehicles is provided in Figure 2-1. The MM-derived launch vehicles to be used in space (orbital) missions are also referred to as Minotaur I or II vehicles, depending on the size of the payload fairing used. Both Minotaur I/II and the MM-derived target vehicles do not represent new launch systems, having been previously launched from Vandenberg AFB. Further discussions on key components of the MM-derived vehicles are provided in the sections that follow.

2.1.1.1.1 Solid-Propellant Booster

For the booster, the MM-derived launch vehicles all utilize MM II rocket motors for the first two stages, and other MM or commercial rocket motors for the third stage and fourth stage (if required). Information on each motor's dimensions, propellant weight, chemical components, and DOD/US Department of Transportation (DOT) explosive classification is provided in Table 2-1. Motor casings are generally made either of steel, titanium, fiberglass, or carbon epoxy. The DOD explosive classification determines the method of shipping and storing of the rocket propellants and other ordnance.

During powered flight, each rocket motor uses a different Thrust Vector Control (TVC) system (steering mechanism) for pitch and yaw control. Although the TVC would vary from motor to motor, two basic

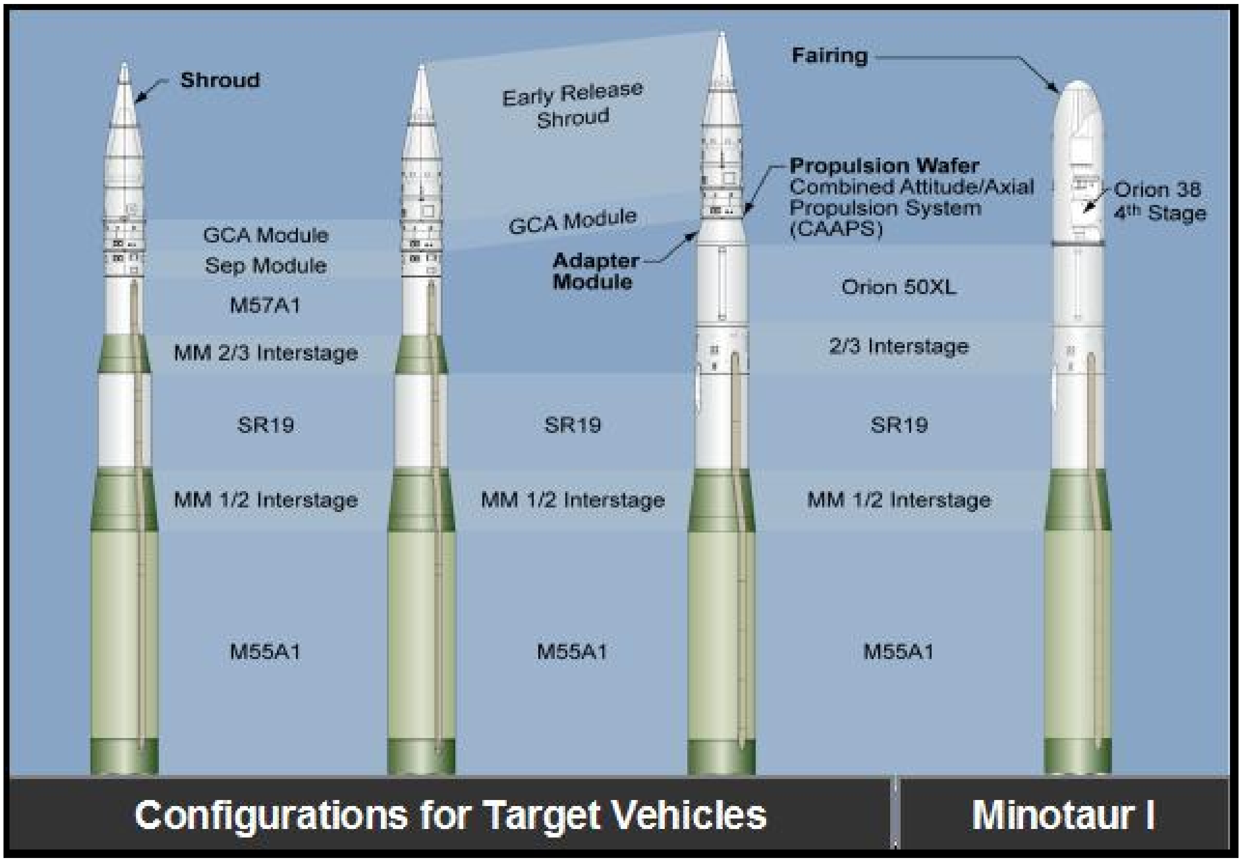


Figure 2-1. Examples of Minuteman-Derived Launch Vehicles

types are used on OSP-selected motors: hydraulically actuated moveable nozzles and liquid/gas injection. Descriptions of each and the materials they use are as follows.

- **Hydraulically Actuated Moveable Nozzles.** This type of TVC system uses a hydraulic system for moving motor exhaust nozzles to alter the thrust vector. A battery-powered motor or gaseous helium powered turbine drives a pump, which maintains hydraulic pressure. Up to several gallons of hydraulic fluid are contained in the system. The MM II M55A-1 motor—the 1st stage on all the MM-derived launch vehicles—uses this type of system.

- **Liquid/Gas Injection.** TVC is accomplished through the injection of a liquid or gas into the rocket's exhaust, which creates a shock wave in the plume that alters the thrust vector. The liquid or gas material used can vary for different motor designs. It can include such materials as perfluorohexane, or strontium perchlorate in an aqueous solution. For the MM II SR19-AJ-1 motor—2nd-stage on all the MM-derived vehicles—260 lb (118 kg) of Halon 2402 gas (also known as Freon 114B2) is used to provide directional steering. Although the Halon gas is a Class I ozone-depleting substance, it represents existing Air Force stockpile from the original MM II Program. Additionally, the Halon was sealed in the TVC tanks during manufacturing; thus, there is no requirement to top off Halon levels or transfer any Halon gas from the launch vehicles. Consequently, in accordance with Air Force Instruction (AFI) 32-7080 (*Pollution Prevention Program*), a waiver for the use of Halon 2402 gas, in this case, is not required. For each of these types of motors, pressurization of the TVC liquid or gas is accomplished using a hot-gas generator, or helium gas stored in a high-pressure tank.

Table 2-1. Solid-Propellant Rocket Motors for Minuteman-Derived Launch Vehicles						
Stage	Motor	Diameter ft (m)	Length ft (m)	Propellant		
				Quantity (approx.) lb (kg)	Main Components	DOD/DOT Classification
1st	M55A-1	5.5 (1.7)	24.6 (7.5)	45,830 (20,788)	Ammonium Perchlorate, Polybutadiene-Acrylic acid-Acrylonitrile, Aluminum	1.3
2nd	SR19-AJ-1	4.3 (1.3)	13.5 (4.1)	13,753 (6,238)	Ammonium Perchlorate, Carboxyl-Terminated Polybutadiene, Aluminum	1.3
	Orion-50XLG	4.2 (1.3)	33.7 (10.3)	33,227 (15,072)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
3rd or 4th	Orion-50XL	4.2 (1.3)	11.8 (3.6)	8,633 (3,916)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
	Orion-38	3.2 (1.0)	4.4 (1.3)	1,699 (771)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
	M57A-1	3.2 (1.0)	7.1 (2.2)	3,660 (1,660)	Ammonium Perchlorate, Cyclotetramethylene Tetranitramine, Aluminum, Nitrocellulose, Nitroglycerine, Triacetin	1.1
	SR73-AJ-1	4.3 (1.3)	5.5 (1.7)	7,290 (3,307)	Ammonium Perchlorate, Carboxyl-Terminated Polybutadiene, Aluminum	1.3
	Star-48	4.1 (1.2)	6.0 (1.8) to 7.3 (2.2)	4,431 (2,010) to 5,357 (2,430)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3

An aft skirt surrounds the base of the 1st stage motor, supporting the launch vehicle while stationary on the launch stool or in the launch silo. Inter-stages are used to connect the motor stages together. A narrow raceway and cable system runs along the exterior of some or all of the stages and the inter-stages. Small amounts of ordnance, in the form of linear explosive assemblies, are used to separate the stages during flight. Other ordnance carried on the booster includes motor igniter assemblies and an ordnance destruct package to initiate a thrust termination action, should a launch anomaly occur.

2.1.1.1.2 Hydrazine Auxiliary Propulsion System (HAPS)

Enhanced insertion accuracy or support for multiple payloads can be provided as an enhanced option utilizing the Hydrazine Auxiliary Propulsion System (HAPS). The HAPS, which is mounted above the solid-propellant booster, inside the Avionics Structure, consists of a hydrazine propulsion subsystem and a stage separation subsystem. After burnout and separation from the booster, the HAPS hydrazine thrusters provide additional velocity, improved performance, and precise orbit injection (orbital missions only) for the payload. The HAPS propulsion subsystem contains approximately 130 lb (59 kg) of liquid hydrazine, and pressurized helium gas. The HAPS may also be used in target vehicle applications.

2.1.1.1.3 Guidance Control Assembly Module/Avionics Assembly

On target (sub-orbital) launch vehicles, the Guidance Control Assembly represents an inertial guidance system that directs the flight of the target missile. It senses the vehicle's position and sends commands to flight control components to keep the target on its planned trajectory. Integrated with the upper stage and/or payload assembly, the Avionics Assembly on orbital launch vehicles also directs the course of the launch vehicle. Components, within both of these systems, usually include the flight computer, telemetry transmitter, telemetry multiplexer, dual flight termination receivers, radar transponder, batteries, and harnesses.

2.1.1.1.4 Payload Assembly

Located at the top of the launch vehicle, the Payload Assembly carries one or more target vehicles/ experimental packages (sub-orbital missions) or spacecraft (orbital missions). The Payload Assembly can be up to 14 ft (4.3 m) long and about 4 ft (1.2 m) in diameter. For orbital missions and some sub-orbital missions, a two-piece protective shroud (or fairing) encloses the payload, protecting it and other launch vehicle components prior to and during the vehicle's ascent after launch. During flight, pyrotechnic bolt cutters sever shroud connections. A contained hot-gas generation system is then used to drive pistons that force the halves of the shroud open, allowing for payload separation.

2.1.1.1.5 Batteries

To provide electrical power to the MM-derived launch vehicle subsystems, several different types of batteries are carried onboard the motors and other sections of the vehicle. They consist of multiple nickel-cadmium and silver-zinc batteries, and two squib batteries. Approximately 12 batteries are carried on the launch vehicle (depending on the vehicle configuration used), each weighing from 6 to 12 lb (2.7 to 5.4 kg).

2.1.1.2 Peacekeeper-Derived Launch Vehicles

Similar to the MM-derived vehicles discussed earlier, the PK-derived launch vehicles would consist of the following vehicle sections: a 3- to 5-stage solid-propellant booster; a Guidance and Control Assembly; and a payload assembly for the target vehicle(s)/experimental package(s) (sub-orbital missions) or spacecraft (orbital missions), including a protective shroud for the payload. Depending on the number of motor stages, payload, and other mission requirements, the overall vehicle length would be approximately 71 to 76 ft (21.6 to 23.2 m) long, with a maximum diameter of 7.7 ft (2.3 m) and a weight of up to approximately 195,000 lb (88,400 kg), not including mass of the payload. The PK-derived launch vehicle to be used for OSP orbital missions is referred to as the Minotaur IV, while the target launch (sub-orbital) vehicle is called the OSP Heavy. A diagram of these launch vehicles is provided in Figure 2-2.

Nearly the same as the PK-derived launch vehicles, the PK ICBM has been flight tested at Vandenberg AFB on a regular basis since 1983. The first-stage motor to be used on the PK-derived vehicles is also the same as or equivalent to those previously used for Taurus missions launched from Vandenberg AFB, and for the Athena Program that has conducted launches from Vandenberg AFB, Kodiak Launch Complex, and Cape Canaveral AFS.

Further discussions on key components of the PK-derived vehicles are provided in the following sections.

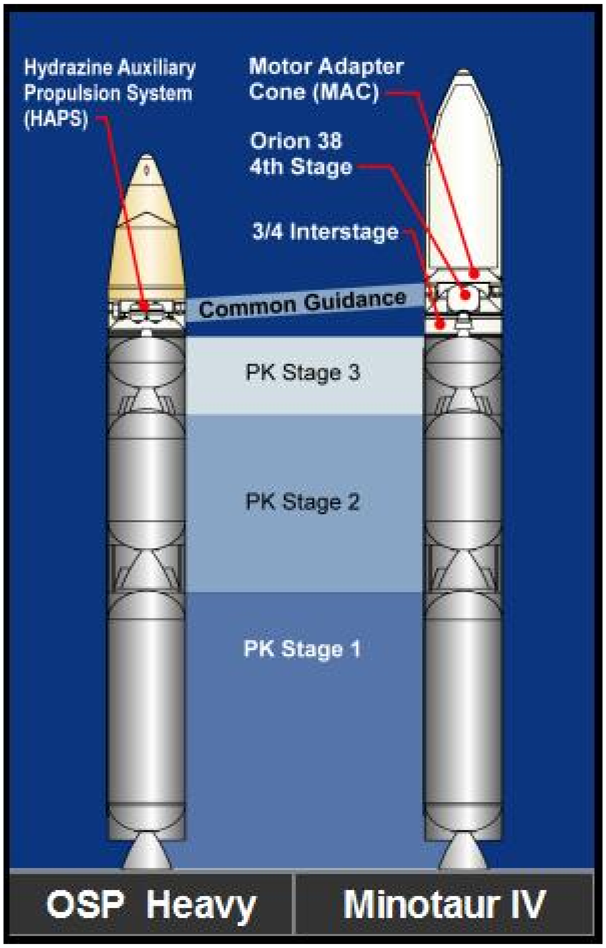


Figure 2-2. Examples of Peacekeeper-Derived Launch Vehicles

2.1.1.2.1 Solid-Propellant Booster

The PK-derived boosters utilize PK rocket motors for the first three stages, and other commercial rocket motors for the fourth and fifth stages (if required). Information on each motor's dimensions, propellant weight, chemical components, and DOD/DOT explosive classification is provided in Table 2-2. The PK motor casings are made primarily of KEVLAR® and carbon epoxy.

The TVC system on all three PK motors uses individual gas generators, with igniters, to power the hydraulically actuated moveable nozzles, similar to those previously described for some of the MM motors. Each PK rocket motor contains several gallons of hydraulic fluid. For the 4th- and 5th-stage commercial rocket motors, the TVC would be the same as described earlier for the MM-derived launch vehicle.

The base of the 1st stage motor would be supported on a launch stool prior to launch. Inter-stages are used to connect the motor stages together. A narrow raceway and cable system runs along the exterior of some or all of the stages and the inter-stages. Small amounts of ordnance, in the form of linear explosive assemblies, are used to separate the stages during flight. Just as with MM-derived boosters, other

Table 2-2. Solid-Propellant Rocket Motors for Peacekeeper-Derived Launch Vehicles

Stage	Motor	Diameter ft (m)	Length ft (m)	Propellant		
				Quantity (approx.) lb (kg)	Main Components	DOD/DOT Classification
1st	SR-118	7.7 (2.3)	27.6 (8.4)	98,462 (44,662)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
2nd	SR-119	7.7 (2.3)	19.7 (6.0)	54,138 (24,557)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
3rd	SR-120	7.7 (2.3)	10.8 (3.3)	15,584 (7,069)	Ammonium Perchlorate, Aluminum, Cyclotetramethylene Tetranitramine, Nitroglycerine, Polyethylene Glycol	1.1
4th	Orion-38	3.2 (1.0)	4.4 (1.3)	1,699 (771)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
	Star-48	4.1 (1.2)	6.0 (1.8) to 7.3 (2.2)	4,431 (2,010) to 5,357 (2,430)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
5th	Star-37	3.1 (0.9)	5.5 (1.7)	2,350 (1,066)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3

ordnance carried onboard would include motor igniter assemblies and an ordnance destruct package to initiate a thrust termination action should a launch anomaly occur.

2.1.1.2.2 Hydrazine Auxiliary Propulsion System (HAPS)

As an option for the PK-derived launch systems, a HAPS propulsion subsystem, similar to that described for the MM-derived systems (Section 2.1.1.1.2), could be used. If used on space or target vehicle applications, the HAPS would contain approximately 130 lb (59 kg) of liquid hydrazine, and pressurized helium gas.

2.1.1.2.3 Guidance and Control Assembly

The PK-derived launch vehicles utilize a Guidance and Control Assembly, which directs the course of the launch vehicle in flight. Components contained within this system usually include the flight computer, telemetry transmitter, telemetry multiplexer, dual flight termination receivers, radar transponder, batteries, and harnesses.

2.1.1.2.4 Payload Assembly

Located at the top of the launch vehicle, the Payload Assembly carries one or more target vehicles/ experimental packages (sub-orbital missions) or spacecraft (orbital missions). It can be up to 20 ft (6.1 m) long and about 7.7 ft (2.3 m) in diameter. For orbital and sub-orbital missions, a two-piece protective shroud or fairing encloses the payload, protecting it prior to and during the vehicle's ascent after launch. During flight, either a small rocket motor would be used to eject the shroud, or linear shaped charges would be used to separate the fairing from the vehicle. Once the shroud or fairing is removed, payload separation can occur.

2.1.1.2.5 Batteries

To provide electrical power for the PK-derived launch vehicles, eight nickel-cadmium batteries are carried on the upper stage. The battery weights range from 3 to 12 pounds (1.4 to 5.4 kg) each. Two batteries are for command destruct systems, two are for ordnance, and the remainder are for avionics power.

2.1.2 SPACECRAFT AND ORBITAL MISSIONS

Under the OSP, a wide variety of small and micro-satellites could be launched from any of the proposed launch sites into LEO. Such orbits are generally 270 to 1,080 nautical miles (nmi) (500 to 2,000 km) above the earth's surface and are not in a fixed position (are not geostationary). Orbital paths can vary from equatorial to polar. Based on a 100-nmi (185-km) orbit insertion altitude, the MM-derived launch vehicles would have a maximum payload capacity of approximately 1,200 lb (545 kg), while the larger PK-derived vehicles would have the ability to boost payloads weighing more than 3,860 lb (1,750 kg). As the orbit insertion altitude increases, the payload capacities of the vehicles decrease.

Orbital missions identified to date for the OSP are the USAF's Space-Based Space Surveillance (SBSS) mission, the MDA's Near Field Infrared Experiment (NFIRE) mission, and the US-sponsored Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) mission. These specific missions, in addition to other representative spacecraft payloads, are described in the sections that follow.

2.1.2.1 Space-Based Space Surveillance

While in LEO, the SBSS spacecraft would provide timely detection, identification, and tracking of man-made space objects. This is accomplished by providing immediate maneuver detection, supporting threat determination and defensive counter space strategies, and delivering significantly improved detection and reporting of high interest space events to ensure survivability of US assets. The SBSS would also enable US forces to find, fix, and track deep-space and near-earth resident space objects, and would support the Space Surveillance Network in maintaining an accurate catalog of all resident space objects. Launch of the SBSS spacecraft is currently planned for 2008 or 2009, and would be conducted from either Vandenberg AFB or Kodiak Launch Complex.

The type and amount of onboard propellants, and other characteristics of the SBSS spacecraft, would fall within the maximum limits identified for the representative spacecraft described in Section 2.1.2.6. An illustration of the proposed SBSS spacecraft is provided in Figure 2-3.

2.1.2.2 Near Field Infrared Experiment

The MDA is embarking on an acquisition strategy that delivers the capability to intercept long-range, enemy ballistic missiles during the boost and ascent phase of their trajectory.[2] Near-field measurements

[2] In the Boost Defense Segment of Ballistic Missile Defense, ballistic missiles are intercepted prior to termination of powered flight during a time when they are moving relatively slowly and have a highly visible plume. For further information on this topic, go to the following MDA web site: http://www.mda.mil.

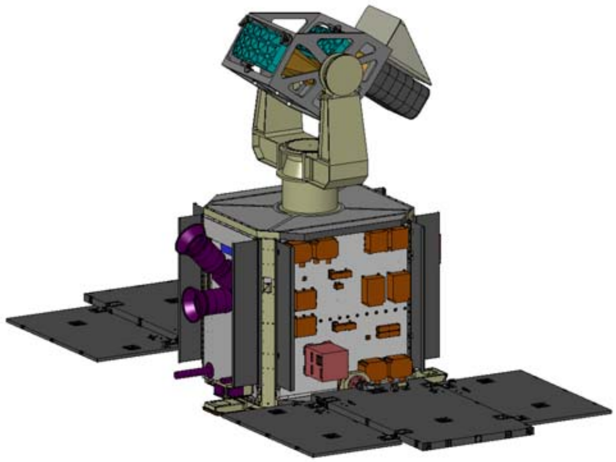


Figure 2-3. Space-Based Space Surveillance (SBSS) Spacecraft

of the exhaust plume and rocket body during boost are one area of remaining technical risk that mandates testing in a realistic space environment. The NFIRE represents a set of on-orbit experiments designed to obtain this much-needed data and reduce the risk for future terrestrial platforms (e.g., ground mobile/air deployable, sea, and potentially air) that are currently in planning.

The NFIRE spacecraft serves as a bus with a liquid hydrazine propulsion system. Composed mostly of aluminum, graphite, steel, and titanium, the spacecraft measures approximately 8.4 ft (2.6 m) high and 4.3 ft (1.3 m) wide, and weighs approximately 1,130 lb (513 kg). The onboard propulsion system would be fueled with up to 251 lb (114 kg) of liquid hydrazine propellant, with gaseous nitrogen as the pressurant. A solar panel, single hydrogen gas battery, and 11 series-connected nickel hydrogen (NiH_2) common pressure vessels would provide electrical power for the spacecraft and onboard passive infrared sensor. A drawing of the proposed spacecraft bus is shown in Figure 2-4.

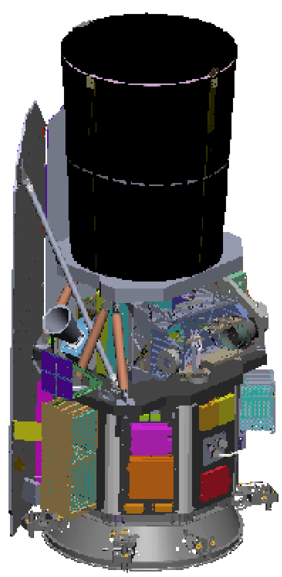


Figure 2-4. Near Field Infrared Experiment (NFIRE) Spacecraft

The NFIRE spacecraft would be launched on a MM-derived Minotaur launch vehicle from Wallops Flight Facility. Spacecraft fueling, and integration with the booster, would occur at Wallops Flight Facility.

Planned for 2006, the NFIRE spacecraft would be launched from Wallops Flight Facility on a southeasterly trajectory. When the launch vehicle reaches the desired orbit, it would deploy the NFIRE spacecraft in a low-earth circular orbit. Over the next several months, the spacecraft would use its onboard sensor to observe targets of opportunity.

Sometime after the NFIRE spacecraft is launched, two MM-derived target vehicles (described in Section 2.1.1.1) would be launched from Vandenberg AFB, several weeks or months apart. With each target flight, the NFIRE spacecraft would maneuver to a lower orbit to observe the passing target vehicle (during its final-stage burn), prior to its splashdown in the Pacific Ocean.

After the second target launch, the NFIRE bus would return to a higher altitude within LEO. There it would remain and observe static fires and other available launches. If remaining fuel permitted, the spacecraft might drop to a lower orbit for one more "near" mission if the opportunity presents itself. Otherwise, the remaining fuel would be used to maintain the parking orbit for the lifetime of the spacecraft.

2.1.2.3 Constellation Observing System for Meteorology, Ionosphere, and Climate

The COSMIC space mission is the third mission of its type initiated by the National Space Program Office of the National Science Council of Taiwan. This program is a collaborative space science mission being sponsored by several US agencies, including NASA, NOAA, the National Science Foundation, and the University Corporation for Atmospheric Research.

The primary goal of the COSMIC mission is to launch a constellation of six micro-satellites into LEO to collect atmospheric data for weather prediction, atmospheric studies, and space weather monitoring to fulfill the research and operational needs. The mission would be launched on a Minotaur I or II launch vehicle from either Vandenberg AFB or Kodiak Launch Complex in late 2005 or early 2006. Following launch and separation of all six spacecraft, the launch vehicle would perform a series of collision/contamination avoidance maneuvers to minimize contamination and potential recontact with the spacecraft. Each spacecraft would perform a series of orbital maneuvers to attain circular orbits in six orbital planes with a goal of reaching a 432-nmi (800-km) altitude.

The individual spacecraft are approximately 3.8 ft (1.2 m) in diameter and 0.5 ft (0.2 m) high, and are stacked into a "spacecraft suite" or cluster that weighs approximately 900 lb (408 kg) (see Figure 2-5). The six individual spacecraft are comprised of an integrated spacecraft platform and three science payloads: a global positioning system (GPS) occultation receiver, an ionospheric photometer, and a tri-band beacon. The onboard propulsion system for each spacecraft would use approximately 14.7 lb (6.7 kg) of hydrazine stored in a propellant tank. Non-explosive actuators would be used to separate each spacecraft following launch. Electrical power on each spacecraft would come from nickel hydride batteries.

2.1.2.4 Representative Spacecraft

The concept of a representative spacecraft provides a benchmark that describes a "bounding case" for quantities and types of materials, emissions, and instrumentation, in addition to the pre-launch activities that support the mission. Within this context, the representative spacecraft provides a comprehensive bounding design for routine orbital satellite payloads. The quantitative levels noted for the representative spacecraft were derived from prior NASA studies (NASA, 2002a) and USAF sources. Highly unusual

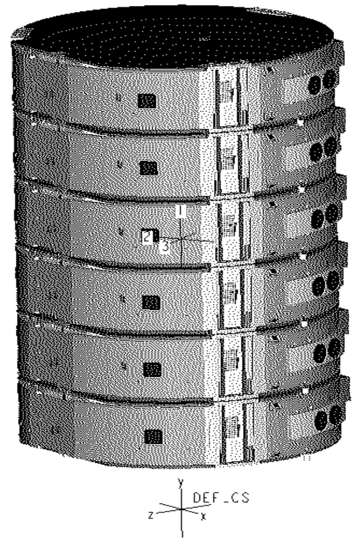


Figure 2-5. Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) Spacecraft Suite

payload characteristics with high potential for major environmental impact (e.g., radioisotope thermoelectric generators) were excluded from this bounding case. Such payload characteristics, if proposed, may require further environmental analyses beyond the scope of this EA. Of the remaining proposed payloads, spacecraft systems with minor potential for environmental impact were identified and evaluated for:

- Solid, liquid, and electric (ion) propellant types and quantities
- Laser power levels and operating characteristics
- Explosive hazard potentials
- Battery electrolyte types and quantities
- Hazardous structural materials and quantities
- Radio frequency transmitter power
- Radioisotope instrument components.

A theoretical bounding case payload was defined by the magnitudes of all of these characteristics. Staying within OSP launch vehicle capabilities for placing satellites into LEO, the representative spacecraft would have a maximum weight of 4,000 lb (1,815 kg). Table 2-3 presents the types and maximum quantities of materials that would be carried by the representative spacecraft. Minor materials that are not listed may be included on the spacecraft, as long as they pose no substantial hazard.

2.1.3 TARGETS AND OTHER SUB-ORBITAL MISSIONS

Target launch vehicles are generally used to simulate a ballistic missile threat, in both physical size and performance characteristics. Missions requiring sub-orbital target launch vehicles are normally conducted in support of DOD Ballistic Missile Defense programs for sensor and interceptor tests, which can involve missile-to-missile impacts at moderate to high altitudes. Such tests are usually conducted over broad ocean areas, distant from populated land areas. In rare cases, other forms of sub-orbital, short-duration flight experiments or demonstration flights may be conducted.

Table 2-3. Summary of Representative Spacecraft Subsystem Characteristics	
Structure	Unlimited quantities: aluminum, magnesium, carbon resin composites, steel, and titanium
	Limited quantities: beryllium [110 lb (50 kg)]
Propulsion	Solid propellant: 280 lb (127 kg)
	Mono-propellant: 460 lb (209 kg) of hydrazine
	Bipropellant fuel: 230 lb (104 kg) of MMH Bipropellant oxidizer: 280 lb (127 kg) of NTO
	Ion propulsion: 230 lb (104 kg) of xenon gas
Communications	Various 10 to 100 Watt (radio frequency) transmitters
Power	Batteries: 150 A-Hr (NiH_2); 300 A-Hr (LiSOC); 150 A-Hr (NiCd); 150 A-Hr (hydrogen gas)
	Solar panels
Instruments	10-kilowatt radar
	American National Standards Institute (ANSI) safe lasers
Other	Limited quantities of radiological materials (typically no more than a few millicuries) approved for launch by applicable USAF and NASA regulations and policies
	Class C (1.4) electro-explosive devices for mechanical systems operation and deployment

Source: Modified from NASA, 2002a

For both MM-derived and PK-derived target launch vehicles, a three-stage solid propellant booster configuration would normally be used (see Section 2.1.1). Payloads carried on target vehicles may consist of a single unshrouded payload, or one or more simulated Reentry Vehicles (RVs) protected within a temporary shroud. A single RV is conical in shape, about 6 ft (1.8 m) tall and 2.5 ft (0.8 m) wide at the base, and weighs approximately 1,300 lb (590 kg). Such RVs and other target payloads may contain a separate telemetry system, power supply, encoders, and transmitters. Used for test purposes only, target payloads typically do not contain radioactive materials, substantial quantities of high explosives, or other weapons materials.

2.1.4 LAUNCH SITES

The OSP proposes to use four existing launch sites: Vandenberg AFB, CA; Kodiak Launch Complex, AK; Cape Canaveral AFS, FL; and Wallops Flight Facility, VA. Program activities planned for each location—including (1) site modifications, (2) rocket motor transportation, (3) pre-flight preparations, (4) flight activities, and (5) post-launch operations—are described in the sections that follow.

As mentioned earlier, only a few specific missions have been identified to date for the OSP. This EA, therefore, takes a programmatic approach in assuming a maximum of five or six launches (orbital and/or sub-orbital) per year, over a 10-year period, beginning in 2005. All five or six annual launches could occur from just one of the four ranges, or could be spread out among the different ranges. Vandenberg AFB and Kodiak Launch Complex would be capable of handling up to six launches per year, while the other two ranges would each have the capability for up to five launches per year.

At each of the four ranges, existing facilities would be used. In identifying specific launch sites and support facilities at each range, the USAF applied various evaluation criteria, which are listed below. Those preferred and alternate facilities (if available) that have initially met the criteria are identified in the sections that follow.

- Minimal construction requirements
- Launch pad large enough to handle logistical support equipment [e.g., crane and Transporter-Erector (TE)]
- Power and communication lines nearby
- Acceptable launch trajectory performance (e.g., avoid doglegs along the flight path to control debris impact areas)
- Minimal environmental constraints
- Ease of operations, and quality and capability of supporting infrastructure
- Meets explosive safety siting requirements for proposed launch systems
- Avoids Strategic Arms Reduction Treaty (START) limitations and constraints
- Minimal cost and schedule constraints or risks.

It is important to note that before any proposed launch activities occur at a launch facility operating under a launch site operator license, coordination between the licensee and the FAA/AST would be required. This is necessary to ensure that the terms and conditions of the license would be met; otherwise, a modification to the license would need to be issued.

2.1.4.1 Vandenberg Air Force Base

Vandenberg AFB is the headquarters of the 30th Space Wing, which conducts space and missile launches, and operates the Western Range. The base hosts a variety of Federal agencies and commercial aerospace companies and activities, including the Spaceport Systems International (SSI) Commercial Spaceport.

In support of the OSP at Vandenberg, multiple launch sites and support facilities would likely be used, including a combination of USAF and commercially operated facilities. As the primary launch site for space (orbital) missions, the SSI Spaceport on South Base would be used to launch both MM-derived and PK-derived vehicles. The SSI Spaceport encompasses approximately 108 acres of property leased from the USAF, and consists of two key facilities: the Commercial Launch Facility (CLF) and the Integrated Processing Facility (IPF). The IPF also houses the CLF Launch Control Room and administrative offices for the launch site. Development and use of the SSI Commercial Spaceport for launches was previously analyzed in the *Environmental Assessment for the California Spaceport, Vandenberg Air Force Base, California* (USAF, 1995).

SSI currently operates the spaceport facility under a launch site operator license issued by the FAA/AST in September 2001. A launch site operator license remains in effect for 5 years from the date of issuance unless surrendered, suspended, or revoked before the expiration of the term, and is renewable upon application by the licensee (14 CFR 420.43). A license to operate a launch site authorizes a licensee to offer its launch site to a launch operator (such as the USAF) for each launch point for the type and weight class of vehicle identified in the license application and upon which the licensing determination is based. The launch site operator license authorizes SSI to conduct Government and licensed launches of orbital expendable vehicles within the small payload weight class [less than or equal to 3,300 lb (1,497 kg)], and with launch azimuths ranging from 168 to 220 degrees from true north, inclusive. Any modifications to the facility or proposed operations would require a modification to the existing launch site operator license.

The primary launch site that would be used for MM target (sub-orbital) launches is Launch Facility-06 (LF-06), which is an existing silo facility located on North Vandenberg AFB. The primary site for PK target launches is Test Pad-01 (TP-01), while the Advanced Ballistic Missile Reentry System (ABRES)-A and ABRES-B complexes are also being considered. The TP-01 and ABRES-A sites have not been used for launches in over 14 years, while the last mission launched from ABRES-B was 38 years ago. Other locations being considered for PK-derived space launches are Space Launch Complex-4 East and West (SLC-4E and SLC-4W, respectively), both of which are available for other missions, following the last Titan IV launch this year. These and other key facilities that may be used in support of the OSP at Vandenberg AFB are listed in Table 2-4. The locations of these facilities are shown in Figure 2-6, along with the range of possible launch azimuths for each launch site.

Depending on mission needs and facility availability, it is possible that other facilities at Vandenberg AFB could later be considered for payload and/or booster processing. For the OSP, it is expected that little or no modifications would be needed at most of the facilities selected for launch support operations. Some launch facilities, however, would require more extensive construction if selected.

For analysis purposes, this EA assumes that Vandenberg AFB would be capable of launching up to two PK-derived and four MM-derived vehicles in any given year during the 10-year period for the OSP. Such launch rates, however, are unlikely to occur every year at the base.

2.1.4.1.1 Site Modifications

For the LF-06 and SSI CLF launch sites, and most of the associated support facilities, no modifications are planned for the OSP.

The Integration Refurbishment Facility (IRF) would require some minor modifications if used in support of PK launches. This would include adding hydrazine-fueling capability to one of the existing bays, increasing the height of the main bay exterior roll-up door to accommodate payload assemblies, and attaching rails and anchors to the main bay floor. All modifications would be conducted within the existing building.

Remaining at the TP-01 launch site is a canister-erector that was previously used to hoist the PK from a trailer and position it vertically. Since the erector is no longer used, the steel structure would be removed. A new aboveground launch stool would need to be installed to support PK target vehicles. A scaffolding-like mobile service tower or gantry measuring approximately 80 ft (24.4 m) tall and 30 ft (9.1 m) wide would be built to provide access to different levels of the launch vehicle, similar to the example shown in Figure 2-7. I-beam rails would be installed in the existing concrete pad for the gantry to ride on. Because of their deteriorated condition (as a result of corrosion), four existing camera towers would need to be removed, and a new single tower emplaced on one of the existing tower pads. In addition, the existing fence surrounding the pad would be repaired and the fenced area expanded on the East-side of TP-01 to ensure adequate rollback clearance for the new gantry. It is expected that no off-pad areas would be disturbed. Vegetation inside and immediately outside the perimeter fence, however, would require mowing periodically to minimize fire hazards from launches.

Because of their disuse for many years, both the ABRES-A and ABRES-B complexes would require a number of modifications and upgrades to support OSP launch operations. Demolition of some existing structures would be needed to eliminate unsafe and/or unusable items. The mobile gantry at the

ABRES-A sites would need to be replaced. At ABRES-B, a new roof would be needed for the launch structures. Other modifications needed at both complexes would include refurbishment of the launch duct; installation of a launch ring; extension of power, water, and communication lines through previously disturbed areas; upgrades or replacement of existing security fencing; resurfacing or replacement of existing access roads; and periodic mowing of vegetation inside and immediately outside the perimeter fence to minimize fire hazards from launches. An engineering analysis of the ABRES-A sites would also be needed to determine if the existing pad area could support the weight of a fully loaded TE and/or

Table 2-4. List of Facilities Proposed to Support the OSP at Vandenberg AFB, California				
Facility / Building Number	**Launch System**	**Mission Type**	**Activity**	**Site Modifications for OSP**
Launch Facilities				
Launch Facility-06 (LF-06) (Bldg 1980)	MM	Target	Launch Site	None
Test Pad-01 (TP-01) (Bldg 1840)	PK	Target	Launch Site	Remove current canister-erector, install launch stool, construct mobile gantry, replace camera towers, repair and expand fencing, and clear vegetation
ABRES-A (Bldg 1788, 1797)	PK	Target	Launch Site	Some demolition and refurbishment, install launch ring, construct mobile gantry, fencing, utility line extensions, road improvements, and clear vegetation
ABRES-B (Bldg 1825, 1835)	PK	Target	Launch Site	Some demolition and refurbishment, install launch ring, fencing, utility line extensions, road improvements, and clear vegetation
Space Launch Complex-4 East (SLC-4E) (Bldg 715)	PK	Space	Launch Site	Replace mobile gantry, modify launch pad structure, install launch ring, and modify road access to pad
Space Launch Complex-4 West (SLC-4W) (Bldg 738)	PK	Target	Launch Site	Replace mobile gantry, modify launch pad structure, install launch ring, and modify road access to pad
SSI Commercial Launch Facility (CLF), (SLC-8) (Bldg 240Z) [1]	MM & PK	Space	Launch Site	None
Other Support Facilities				
SSI Integrated Processing Facility (IPF) (Bldg 375) [1]	MM & PK	Space	Payload Processing	None
Payload Assembly Building (Bldg 8415)	MM & PK	Target	Payload Processing	None
Missile Assembly Building (MAB) (Bldg 1819)	MM & PK	Space & Target	Booster/Payload Processing	None
Astrotech Payload Processing Facility (Bldg 1032)	MM & PK	Space	Payload Processing	None
Payload Processing Facility (Bldg 2520)	MM &PK	Space	Payload Processing	None
Experimental Payload Facility (XPF) (Bldg 6527)	MM & PK	Space & Target	Payload Processing	None
NASA Payload Processing Facility (Bldg 1610)	MM & PK	Space & Target	Payload Processing	None
Missile Processing Facility-2 (MPF-2) (Bldg 6816)	MM	Space & Target	Booster Processing	None
Stage Processing Facilities A & B (Bldgs 1824 and 1833)	PK	Space & Target	Booster Processing	None
Integration Refurbishment Facility (IRF) (Bldg 1900)	PK	Space & Target	Booster/Payload Processing	Add hydrazine fueling capability, increase height of main bay exterior roll-up door, and attach rails and anchors to floor

Table 2-4. List of Facilities Proposed to Support the OSP at Vandenberg AFB, California				
Facility / Building Number	**Launch System**	**Mission Type**	**Activity**	**Site Modifications for OSP**
Stage Storage Facility (576-F) (Bldg 1836)	PK	Space & Target	Motor Storage	None
Integrated Checkout Facility (Bldg 1806)	MM & PK	Space & Target	Motor/Payload Processing	None
Mechanical Maintenance Facility (Bldg 1800)	MM & PK	Space & Target	Booster/Payload Processing	None
Pegasus Assembly Building (Bldg 1555)	MM	Space & Target	Motor/Payload Processing	None
Rail Transfer Facility (Bldg 1886)	PK	Space & Target	Motor/Payload Transfer	None

[1] Commercial facility licensed by the FAA/AST.

mobile cranes. Following the engineering analysis, if it is determined that the ABRES-A sites do not have the necessary load capacity, they would be rejected from consideration for OSP missions.

The last Titan II launch from SLC-4W occurred in October 2003. The pad has since been deactivated and is currently not in use. With the last Titan IV launch from SLC-4E scheduled this year, both SLC-4 pads will be available for reuse in support of other missions. Reuse of either pad for proposed OSP missions, however, would require major modifications. As part of these modifications, the existing mobile gantry would be removed and replaced, a new launch ring installed, and the launch duct resurfaced. Because the roof area of the existing SLC-4W pad would not support the OSP launch vehicle, mobile crane, and transportation equipment, other structural and road access modifications would be needed. Pending further investigations, it may be determined that similar modifications would be needed for the SLC-4E pad.

As part of the demolition-related activities that would occur at the ABRES and SLC-4 sites, depending on which facilities are selected, explosives may be used to weaken select concrete and steel structural members. However, use of explosives for demolition activities would be a rare occurrence, and would require pre-approval from the Safety Office on base.

Note that in the preparation of this OSP EA, design plans for the ABRES and SLC-4 sites were not available, and the plans are not expected until additional engineering and operational concept studies are completed. As such, should either of the ABRES or SLC-4 sites be selected for OSP missions, additional NEPA analyses and agency consultations may be required prior to initiating construction activities and launch operations.

Also, under a separate NEPA analysis, Vandenberg AFB is in the process of completing a Programmatic EA on the demolition and abandonment of multiple Atlas and Titan Heritage program buildings and facilities that are no longer required to sustain base missions. Some of the ABRES-B and SLC-4 launch facilities, analyzed in this EA for proposed OSP missions, are included in the actions analyzed in the Programmatic EA. Thus, the USAF has been closely coordinating the preparation of both EAs.

2.1.4.1.2 Rocket Motor Transportation

Both MM and PK rocket motors would be removed from storage, and inspected and tested for flight worthiness at Hill AFB, Utah, prior to shipment to Vandenberg AFB.

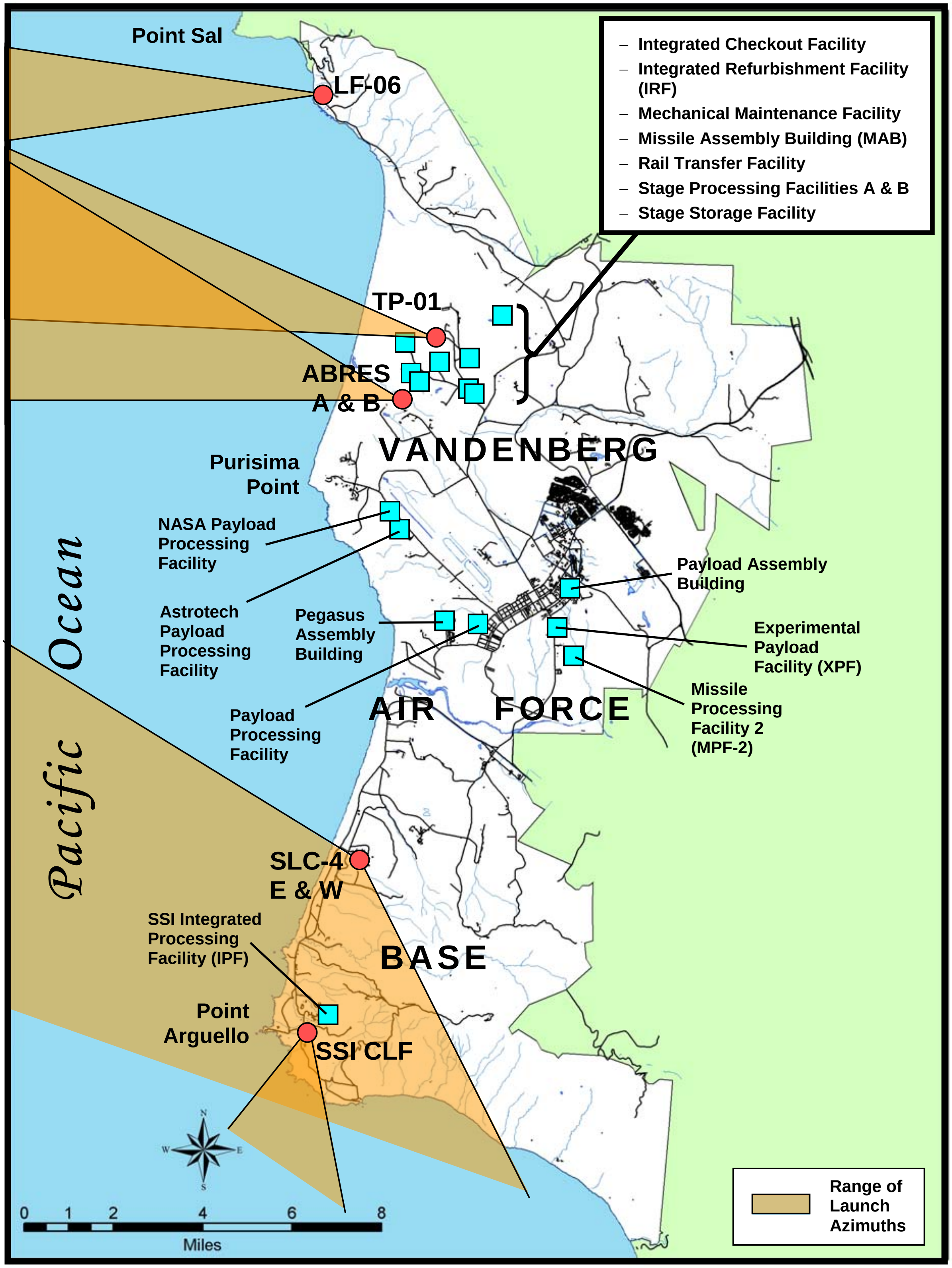


Figure 2-6. Facilities Proposed to Support the OSP at Vandenberg AFB, California

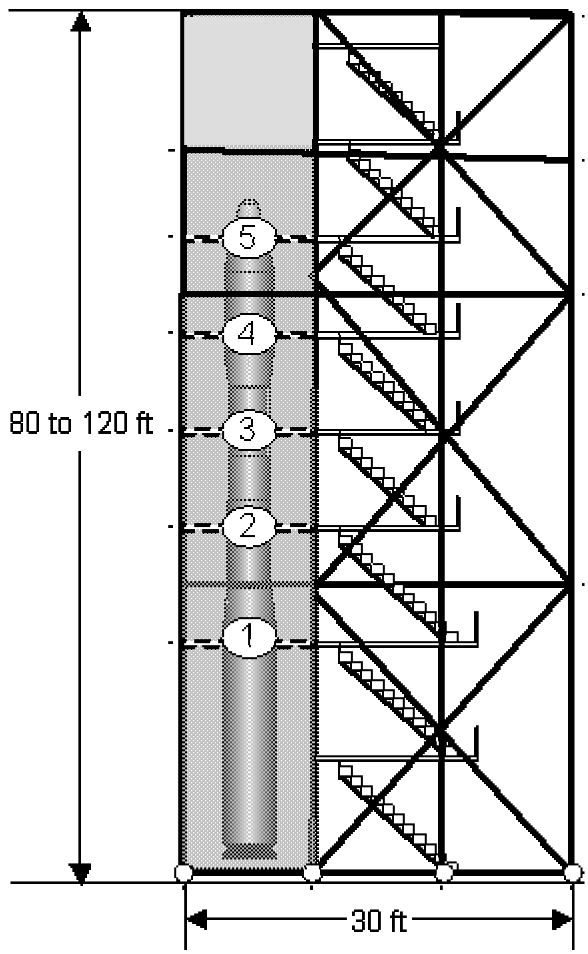


Figure 2-7. Representation of a Mobile Service Tower (Gantry)

At Hill AFB, the first two or three stages of a MM-derived launch vehicle would be integrated into a single booster stack. This would involve the M55A-1 (1st stage), SR19-AJ-1 (2nd stage), and—depending on launch vehicle configuration—an M57A-1 or SR73-AJ-1 (3rd stage) motor. From Hill AFB, the two- or three-stage booster would be transported to Vandenberg AFB by truck in a Missile Transporter (MT) trailer. The heavily constructed MT includes individual carriage supports for each motor, and environmental controls to ensure safe travel over public transportation routes.

The first three stages of PK-derived launch vehicles (SR-118, SR-119, and SR-120) would be individually shipped to Vandenberg AFB from Hill AFB by truck and/or rail using specialized equipment to handle the heavy motors. The PK 1st-stage SR-118 motor, which weighs in excess of 100,000 lb (45,360 kg), would be shipped to the base by rail whenever possible, and offloaded at the Integrated Refurbishment Facility (using overhead cranes) or at the Rail Transfer Facility (using mobile cranes). For over-the-road transportation, a multi-axle, heavy haul commercial trailer would be used. This type of semi-trailer has several steerable axles, and a suspension system that provides road shock isolation and leveling capability. A Type II semi-trailer and tractor, with eight axles, could also be used for the smaller and lighter-weight 2nd- and 3rd-stage motors (SR-119 and SR-120, respectively).

The smaller commercial motors used for both MM- and PK-derived upper stages (Orion-50XL, Orion-38, and Star-48) would most likely be shipped to Vandenberg AFB by truck directly from the manufacturer. This would also include the Orion 50XLG motor if used for the 2nd stage on MM-derived space launches, instead of the SR19-AJ-1. Each motor would be transported in a protective carriage or container.

All transportation, handling, and storage of the rocket motors and other ordnance would be accomplished in accordance with DOD, USAF, and US Department of Transportation (DOT) policies and regulations to safeguard the materials from fire or other mishap. This would include obtaining any necessary oversize/overweight hauling permits from each state where transportation would occur. The transport of MM and PK motors, and commercial motors, to Vandenberg AFB is a routine operation conducted several times a year.

To support implementation of the OSP at Vandenberg AFB and at the other proposed launch sites, a detailed transportation plan for moving MM rocket motors has been prepared (TRW, 2002). A separate transportation and handling plan for moving the larger PK rocket motors to Vandenberg AFB is also available (Northrop Grumman, 2005). These plans address the shipping and handling of the motors using air, road, rail, and/or water modes of transport, and applicable regulatory requirements.

2.1.4.1.3 Pre-Flight Preparations

Once the rocket motors or booster arrive at Vandenberg, they would be inspected and taken either to an existing bunker for temporary storage or moved directly to one of the motor/booster processing facilities listed in Table 2-4 to initiate booster integration and checkout. During motor/booster processing, a destruct package with small quantities of ordnance would be added. The purpose of the destruct package is to terminate motor thrust if unsafe conditions develop during powered flight.

Following booster processing and integration for MM-derived launch vehicles, the lower stack assembly would be transferred to a TE and driven to the designated launch site. Once at the launch pad, the TE would be secured with tie-downs. The TE is used to erect the booster assembly into a vertical position. For operations at the SSI CLF, a crane would be used to lift the booster assembly from the TE and position it onto the launch stool. After placement of the lower stack assembly, the mobile work stand is positioned to provide access to the upper end in preparation for integration of the upper stack. The TE is then used again to transport the upper motor stack and payload assembly from the designated processing facility. The erection process is repeated at the CLF launch site, completing the MM launch vehicle's assembly.

For three-stage MM target launches from LF-06 on North Base, the TE would lower the vehicle into the silo in preparation for launch. The target payload assembly is then transported in a payload transporter to the LF for placement on top of the booster. Prior to each launch at LF-06, a protective silicon rubber sealant is manually applied (not sprayed) to cable pass-through holes and other openings along the launch tube walls of the LF. This sealant prevents rocket exhaust gases from damaging the facility.

As for PK-derived launch vehicles, the PK motors would be transported individually to the designated launch site, where a mobile crane would stack them on the launch stand one at a time. The payload assembly is installed last. The mobile gantry would provide worker access to each stage of the launch vehicle. This general process of launch vehicle integration would be used at any of the proposed PK launch sites at Vandenberg AFB (i.e., TP-01, ABRES-A or -B, SLC-4E or -4W, and SSI).

Orbital spacecraft and sub-orbital target payloads would arrive at Vandenberg AFB via truck or military aircraft and be taken to one of the payload processing facilities listed in Table 2-4. The spacecraft and target systems would be processed about the same time as the booster components. At the processing facility, various system and subsystem tests would be conducted, as well as the loading of liquid propellant(s) onto payloads, if required. Fueling of the HAPS (if used) would also occur at this time. The one or more spacecraft would then be integrated with the upper booster stack (MM-derived vehicles only) and encapsulated with a protective shroud or fairing. MM-derived target payloads/RVs may or may not require a shroud. For PK-derived launch vehicles, the payload assembly, containing the spacecraft or RVs, is transported to the launch site separately for installation onto the completed booster stack.

2.1.4.1.4 Flight Activities

On the day of launch, final vehicle closeout and appropriate arming operations are performed. At each launch site, the gantry is retracted in preparation for countdown and launch. Launch operations at the CLF are conducted from the IPF Launch Control Room, which is located on the hardened side of the IPF. The control centers for the other proposed OSP launch sites are located in facilities remote from the launch sites.

Prior to conducting each launch, USAF personnel conduct a comprehensive safety analysis to determine specific launch and flight hazards. A standard dispersion computer model, run by installation safety personnel, would be used for both normal and aborted launch scenarios. As part of this analysis, risks to off-base areas and non-participating aircraft, sea vessels, and personnel are determined. The results of this analysis are used to identify the launch hazard area, expended booster drop zones, and a terminal hazard area for shroud components, RVs, or other sub-orbital payloads. A flight termination boundary along the vehicle flight path is also predetermined, should a launch vehicle malfunction or flight termination action occur. The flight termination boundary defines the limits at which command flight termination would be initiated in order to contain the vehicle and its debris within predetermined hazard and warning areas, thus minimizing the risk to test support personnel and the general public.

As a normal procedure, commercial and private aircraft, and watercraft, are notified of all the hazard areas several days prior to launch through a Notice to Airmen (NOTAM) and Notice to Mariners (NOTMAR), respectively. Within a day prior to each launch, radar, helicopters, and other remote sensors are used to verify that the hazard areas are clear of non-mission-essential aircraft, vessels, and personnel. Recreational areas in the vicinity of the base may require closure for some launches—typically for less than a day—depending on the launch site and launch trajectory used. Train movements through the base are also coordinated and monitored.

The USAF also notifies oilrig companies of an upcoming launch event several days in advance. The notification requests that operations on the oilrigs, in the path of the launch vehicle overflight, be temporarily suspended and personnel evacuated or sheltered.

Should a launch vehicle head off course or should other problems occur during flight, the Missile Flight Control Officer would activate the destruct package on the vehicle. The signal to destruct is initiated by receipt of a radio command from the base. The destruct package also contains the logic to detect a premature separation of the booster stages and initiate a thrust termination action on its own. Thrust is terminated by initiation of an explosive charge that splits or vents the motor casing, releasing pressure and essentially stopping propellant combustion. This would stop the vehicle’s forward thrust, and the vehicle would then fall along a ballistic trajectory into the ocean.

2.1.4.1.5 Post-Launch Operations

Following vehicle liftoff from the launch pad, the pad would be checked for safe access. Post-launch activities would include inspection of the launch pad facilities, launch platform, and equipment for damage, as well as general cleanup and performance of maintenance and repairs necessary to accommodate the next launch cycle.

For launches from the LF-06 silo, post-launch refurbishment includes the replacement of cables and other damaged components, and the painting of components (e.g., launch vehicle suspension system) for corrosion control. In addition, the silicon rubber sealant applied to the tube walls, prior to launch, must be scraped from holes and openings, and collected in a single 55-gallon (gal) [208-liter (L)] drum for disposal as a hazardous waste. Also, after every four flights, the walls of the launch tube are hand brushed to remove accumulated blast residues. The residues are swept up and collected in 55-gal (208-L) drums for disposal as hazardous waste.

The expended rocket motors and other vehicle hardware are not recovered from the ocean following flight.

2.1.4.2 Kodiak Launch Complex

Kodiak Launch Complex is located on Narrow Cape of Kodiak Island, Alaska, approximately 44 mi (71 km) south of the city of Kodiak by road and 250 mi (402 km) south of Anchorage. The complex was built and is operated by the Alaska Aerospace Development Corporation (AADC). Development and use of Kodiak Launch Complex for launches was previously analyzed in the *Environmental Assessment of the Kodiak Launch Complex, Kodiak Island, Alaska* (FAA/AST, 1996). The Kodiak Launch Complex is licensed by FAA/AST to conduct up to nine launches per year. The *Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR) Final Environmental Impact Statement* (USASMDC, 2003) analyzed the impacts of five of these nine launches being used for missile defense testing.

The FAA/AST issued a license to the AADC for the operation of a launch site at the Kodiak Launch Complex in 1998, which allowed for the first sub-orbital launch from the site in November 1998 and the first orbital launch in September 2001. For continued operation of the site, the FAA/AST issued a license renewal in 2003. The launch site operator license authorizes AADC to operate a facility to launch Government and licensed launches of vehicles weighing less than 500,000 lb (226,800 kg) total with solid rocket motor primary stages less than 369,000 lb (167,380 kg) of Class 1, Division 3 explosives. Any modifications to the facility or proposed operations would require a modification to the existing launch site operator license.

The Kodiak Launch Complex is an all-weather complex located on 3,717-acres of state owned land. The primary facilities, which would be used in support of the OSP, are listed in Table 2-5 and shown in Figure 2-8, along with the range of possible launch azimuths for the site.

Table 2-5. List of Facilities Proposed to Support the OSP at Kodiak Launch Complex, Alaska

Facility / Building	Activity	Site Modifications for OSP
Launch Service Structure/Pad 1 [1]	Launch Site	None
Integration and Processing Facility [1]	Motor/Payload Processing	None
Payload Processing Facility [1]	Payload Processing	None

[1] Commercial facility licensed by the FAA/AST.

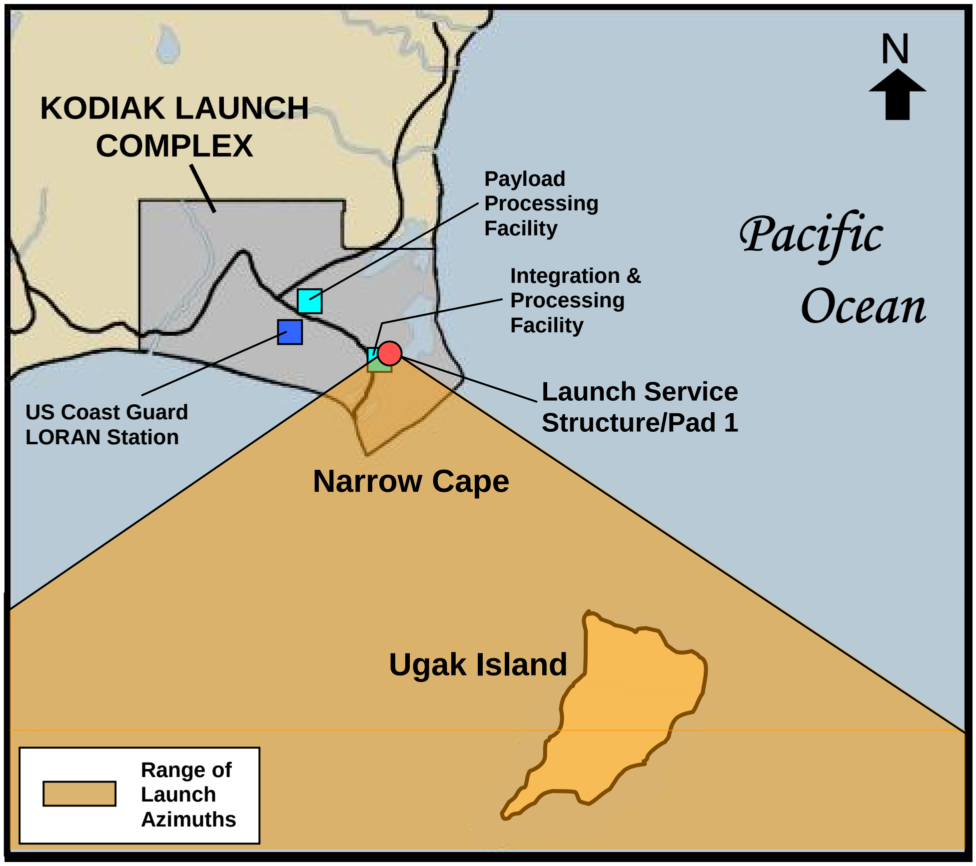


Figure 2-8. Facilities Proposed to Support the OSP at Kodiak Launch Complex, Alaska

For analysis purposes, this EA assumes that Kodiak Launch Complex would be capable of launching up to two PK-derived and four MM-derived vehicles in any given year during the 10-year period for the OSP. Such launch rates, however, are unlikely to occur every year at the complex.

2.1.4.2.1 Site Modifications

The Launch Pad and Service Structure is an environmentally conditioned facility that allows the launch vehicle and payload to be readied for launch entirely indoors. The Launch Service Structure lifts the spacecraft assembly from the horizontal to the vertical position and encloses it until the time of launch. The Launch Service Structure has adjustable work platforms with custom designed inserts that accommodate MM- and PK-derived vehicles, launch stools for both the PK and MM family of vehicles, and a flame trench rated for vehicles larger than those proposed for use under the OSP.

Because of recent facility improvements at Kodiak Launch Complex, no site modifications would be needed to support OSP launches.

2.1.4.2.2 Rocket Motor Transportation

Two options are available for the shipment of rocket motors to Kodiak Launch Complex. The motors can be flown into the Kodiak airport or ocean barged to the Lash Wharf located on Women's Bay, 8 mi (12 km) south of the City of Kodiak.

Individual MM motors, the PK 3rd-stage motor (SR-120), and commercial rocket motors would most likely be flown from Hill AFB, or from other USAF installations (depending on location of the motor supplier), directly to Kodiak airport. Either C-141, C-17, or C-5 military transport aircraft would be used. The airport is restricted to the delivery of DOD Classification 1.1 explosives after normal airport operations, which is from 2300 to 0700. The explosive quantity-distance radius from the offloading site for Class 1.1 explosives encroaches on the airport terminal inhabitance. Therefore, rocket motor shipments must arrive after the 2300 closing time, and must depart the airport area before airport operations resume at 0700.

Because of their higher weights, PK 1st- and 2nd-stage motors (SR-118 and SR-119, respectively), and integrated MM booster stacks, would need to be transported by sea from existing port facilities in Seattle, Washington, to Kodiak Island. The ocean transport of similar-size rocket motors from Seattle to Kodiak Island was previously conducted for the Athena program in 2001.

In a similar manner as used for Vandenberg AFB, the MM booster stack would be shipped from Hill AFB to Seattle over public roads in an MT trailer. The two PK motors would be shipped from Hill AFB to Seattle by rail whenever possible. If the motors were to be shipped by truck, a multi-axle heavy haul commercial trailer would likely be used, especially for the PK 1st-stage motor. A Type II semi-trailer and tractor could also be used for the smaller and lighter-weight PK 2nd-stage motor. During transit over public roads and transfer at the port facilities, the motors cannot be parked at any point for a period of more than 24 hours, in accordance with DOD, US Coast Guard, and local regulations. In Seattle, only port facilities licensed to handle explosives and hazardous materials, including rocket motors, would be used.

From Seattle, the trip up the Canadian and Alaskan coasts would take approximately 11 days and four ports-of-call before arriving at Lash Wharf on Kodiak Island. With favorable tide conditions, this arrangement would allow for a straight drive-off for the MT or heavy hauler from the barge. As an option, large boom cranes are available for offloading containerized rocket motors. Lash Wharf is also licensed to handle explosives and hazardous materials, including rocket motors.

The roads on Kodiak Island are bound by seasonal weight/load restrictions that are imposed by the Alaska DOT for all vehicles over 10,000 lb (4,536 kg) Gross Vehicle Weight (GVW). Such restrictions can reduce the allowable GVW by as much as 50 percent, depending on conditions. The restrictions are very dependent upon weather and frost depths. Though a portion of the road going south to Kodiak Launch Complex is currently unpaved crushed rock, it is scheduled for paving in 2005.

Just as described earlier for Vandenberg AFB, the transportation, handling, and storage requirements for rocket motors and related ordnance would be accomplished in accordance with DOD, USAF, US DOT, and applicable US Coast Guard policies and regulations to safeguard the materials from fire or other mishap. This would include obtaining any necessary oversize/overweight hauling permits from each state where transportation would occur.

In addition, the Alaska DOT requires a lead pilot vehicle for oversize and large hazardous material movements. All vehicles would be outfitted with the necessary communication equipment. These vehicles and personnel would control traffic through narrow or curved areas where there is not enough room for two vehicles to pass. They would also warn motorists of the oncoming vehicle or convoy, and transmit to the vehicle or convoy any forward anomalies. A team of personnel experienced in explosive ordnance handling would trail the convoy from Kodiak airport, or Lash Wharf, south to Kodiak Launch Complex.

As previously described for Vandenberg AFB, a detailed transportation plan for moving MM rocket motors has been prepared (TRW, 2002). A similar plan for the shipping and handling of PK rocket motors to Kodiak Launch Complex would also be developed prior to any missions at the complex that would utilize PK-derived launch vehicles.

2.1.4.2.3 Pre-Flight Preparations

The rocket motors would arrive at the Integration and Processing Facility. This facility is used to receive, stage, process, and check out components before being moved to the Launch Service Structure/Pad 1. The processing of target and spacecraft payloads would be conducted in the Integration and Processing Facility, or in the Payload Processing Facility's clean room. If required, liquid fueling of the payload and HAPS (if used) could be conducted at either of these two facilities.

After completion of booster processing and integration for MM-derived launch vehicles, the lower stack assembly would be transferred to a TE and driven to the launch facility. Once secured with tie-downs, the TE would erect the booster into a vertical position. The lower stack would be off-loaded from the TE using the existing 75-ton (68-metric ton) bridge crane in the Launch Service Structure, and placed on the launch stand. The process is then repeated for the upper stack/payload assembly. For PK-derived launch vehicles, motor stages and the payload assembly would be individually stacked on the launch stand using the Launch Service Structure's bridge crane. The Launch Service Structure would enclose the launch vehicle until the day of launch to provide environmentally controlled conditions for workers and to meet vehicle/payload thermal conditioning specifications.

For public safety, access to beach and other recreational use areas may be restricted for hours at a time during hazardous operations (e.g., stacking rocket motors on the launch pad) in accordance with procedures specified in the Kodiak Launch Complex Range Safety Manual (AADC, 2003a).

2.1.4.2.4 Flight Activities

When a rocket launch is planned, a Launch-Specific Safety Plan is prepared to identify the potential hazards and describe the system designs and methods employed to control the hazards. Booster drop zones and debris impact areas are pre-determined by the Range Safety Office. Clearance areas are identified, encompassing the maximum probable distribution of debris or impact points of rocket components.

The Range Safety Office would communicate the extent of the clearance area, time, and date of the flight, once they are defined, to the FAA regional air traffic office, the US Coast Guard, and local police jurisdictions for assistance in the clearance of designated land and sea-surface areas. NOTAMs and NOTMARs would be issued at least 24 hours prior to launch. Other areas under the initial flight path, but not in a predicted impact or debris area, would be monitored before the test event to determine the location of population or traffic. If the Range Safety Office determined that the population or ship traffic was in a safe position, the test would proceed. Based on operational experience at Kodiak Launch Complex, public access to Narrow Cape would be denied to meet safety and security concerns on average 5 hours in total per launch mission.

Should the launch vehicle head off course, such that it departs from its predicted flight corridor, the Mission Flight Control Officer would activate the onboard destruct package. This would stop the flight vehicle's forward thrust, and the vehicle would fall into the ocean. This impact could occur outside cleared areas, but within a wider predetermined impact corridor.

2.1.4.2.5 Post-Launch Operations

After each launch, the pad area would be checked for safe access. The launch pad facilities and equipment would be inspected for damage and cleaned, as necessary. Equipment maintenance and any repairs would also occur to accommodate the next launch cycle.

Again, the expended rocket motors and other vehicle hardware are not recovered from the ocean following flight.

2.1.4.3 Cape Canaveral Air Force Station

Cape Canaveral AFS falls under the command of the 45th Space Wing headquartered at Patrick AFB, which is located 20 mi (32 km) south of the Cape. As part of the Eastern Range, the Cape supports a wide range of space launches for both US Government and commercial satellites.

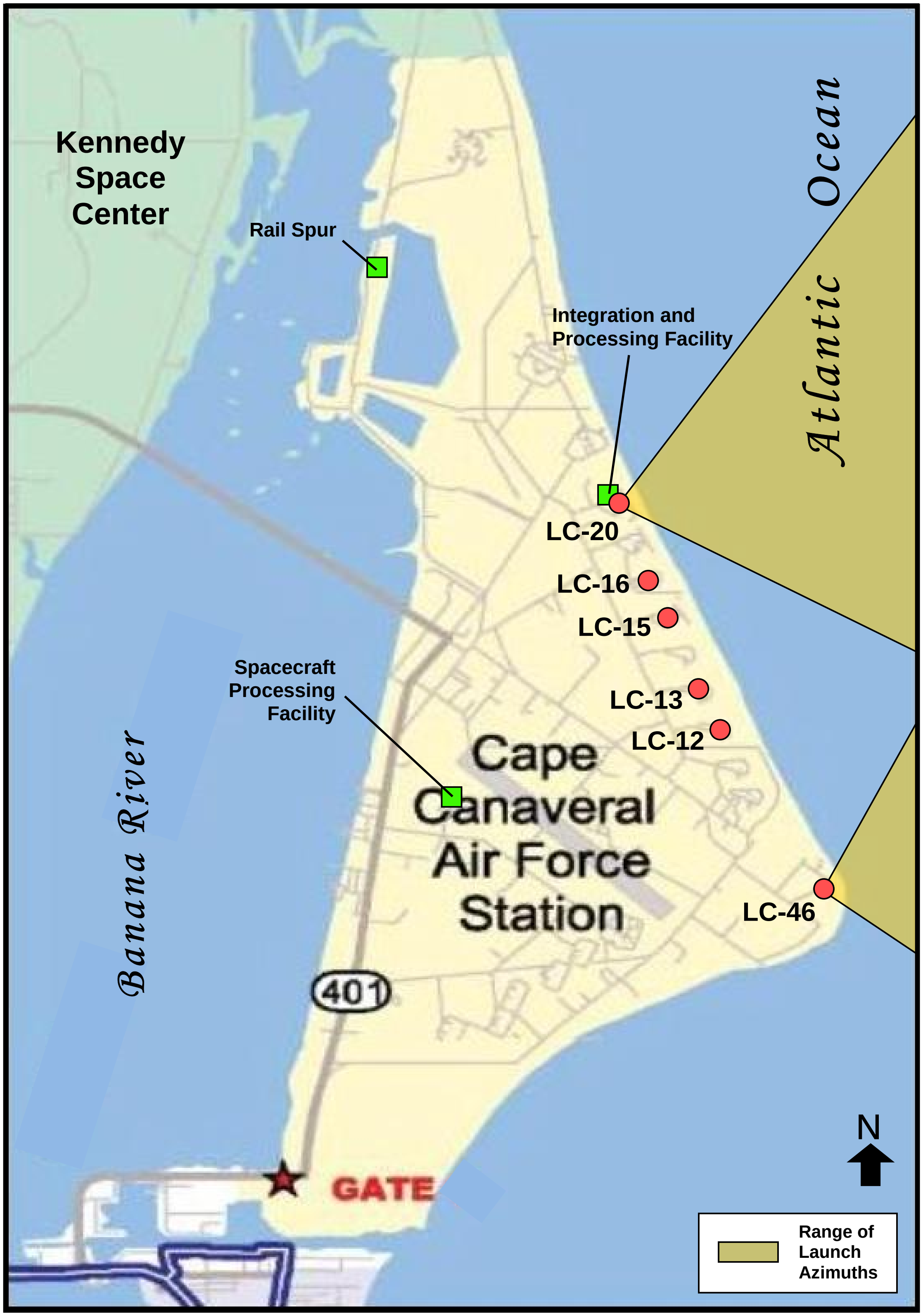
In support of the OSP at the Cape, Government operated facilities would most likely be used. Although the selection of specific facilities for OSP use has not yet been determined, there are several possible launch complexes at the Cape that could support OSP missions. They include Launch Complexes (LC) 12, 13, 15, 16, 20, and 46, which are shown in Figure 2-9. For analysis purposes in the preparation of this EA, only LC-20 and LC-46, the two outermost complexes within this group, were analyzed in detail as representing the range of possible launch sites that could be used in support of the OSP. These two launch sites are further described below.

LC-46 is considered one of the best launch sites at the Cape because of its remoteness on the far eastern side of the installation. Development and use of LC-46 for spaceport operations was previously analyzed in the *Finding of No Significant Impact and Environmental Assessment of the Proposed Spaceport Florida Authority Commercial Launch Program at Launch Complex-46 at the Cape Canaveral Air Station, Florida* (CCAFS/Authority, 1994). Conducting launches from LC-46 would require approval from the Navy and coordination with the Naval Ordnance Test Unit (NOTU). Use of this facility would also require satisfactory resolution of START treaty issues associated with Peacekeeper-derived launch vehicles.

LC-20 provides a processing and launch capability for small-scale rockets. This capability is currently being augmented with additional facilities for NASA's Advanced Technology Development Center (ATDC), which will provide resources for the research, development, demonstration, testing, and qualification of spaceport and range technologies (NASA, 2001b). Initial development of the ATDC should be completed in 2006. Conducting OSP launches from LC-20 would require approval from NASA, and sharing use of the launch complex with ATDC operations.

Table 2-6 lists representative facilities that could potentially be used in support of the OSP at Cape Canaveral AFS. The locations of these facilities are also shown on Figure 2-9, along with the range of possible launch azimuths for LC-20 and LC-46. Once OSP mission needs and facility availability are determined, other facilities at the Cape may also be considered. For the OSP, it is expected that little or no modifications would be needed for any of the facilities selected for launch support operations. Depending on which facilities at Cape Canaveral AFS are eventually selected for the OSP, additional environmental analyses beyond this EA may be required prior to initiating facility modifications and launch operations.

For analysis purposes, this EA assumes that Cape Canaveral AFS would be capable of launching up to two PK-derived and three MM-derived vehicles in any given year during the 10-year period for the OSP. Such launch rates, however, are unlikely to occur every year at the station.



Note: In preparation of this EA, only two of the possible launch sites (LC-20 and LC-46) were analyzed in detail.

Figure 2-9. Representative Facilities Proposed to Support the OSP at Cape Canaveral AFS, Florida

Table 2-6. List of Representative Facilities Proposed to Support the OSP at Cape Canaveral AFS, Florida		
Facility / Building	**Activity**	**Site Modifications for OSP**
Launch Complex-20 (LC-20)	Launch Site	Install launch stool, construct mobile gantry with an environmental shelter, and install tie-downs for the TE
Launch Complex-46 (LC-46)	Launch Site	Install tie-downs for the TE, a new launch ring, and an environmental shelter inside the existing Mobile Service Structure
Integration and Processing Facility at LC-20	Motor/Payload Processing	None
Spacecraft Processing Facility	Payload Processing	None
Rail Spur	Motor/Payload Transfer	None

2.1.4.3.1 Site Modifications

Most likely for any LC selected, some level of site modifications would be necessary. At LC-46, for example, several modifications would be needed. For the TE to be positioned next to the launch stool, it must be supported in six places to erect MM-derived boosters. Two pylon pads, two erector jack pads, and two gear pad footings would be installed in the existing concrete pad. An existing launch stool would be bolted over the existing flame exhaust duct used previously for Navy Trident missile launches. The stool, however, would require installation of a new launch ring to accommodate MM or PK 1st-stage motors. In addition, an environmental enclosure may need to be built inside the existing Mobile Service Structure (MSS) or gantry in order to keep the launch vehicle sufficiently cool during hot weather. As an alternative to the shelter, a cooling blanket could be wrapped around the rocket motors prior to launch. All site construction and/or modifications would be limited to the existing concrete pad and MSS.

At LC-20, a launch stool would be installed and a mobile gantry approximately 90 to 120 ft (27.4 to 36.6 m) high and 30 ft (9.1 m) wide would be constructed on rails, similar to that described earlier for Vandenberg AFB and shown in Figure 2-7. Just as with the existing MSS at LC-46, an environmental shelter would be integrated with the new gantry. Construction is expected to occur within existing paved areas. Should construction require excavation and/or the clearing of vegetation, additional environmental analyses and agency consultations beyond this EA would be necessary before such construction could occur.

2.1.4.3.2 Rocket Motor Transportation

Just as described earlier for Vandenberg AFB, the first two or three stages of a MM-derived launch vehicle would likely be shipped from Hill AFB to Cape Canaveral AFS over public roads in an MT trailer. Smaller commercial motors for the upper stages would either be trucked or flown directly to the Cape, which has a runway accessible to C-141, C-17, and C-5 aircraft.

The PK motors would be shipped from Hill AFB to Cape Canaveral AFS by rail whenever possible. If the motors were to be shipped by truck, a multi-axle heavy haul commercial trailer would likely be used, especially for the PK 1st-stage motor (SR-118). A Type II semi-trailer and tractor could also be used for the smaller and lighter-weight PK 2nd- and 3rd-stage motors (SR-119 and SR-120, respectively). Travel would be mostly over interstate highways and would take approximately 8 to 9 days.

When shipped by rail to Cape Canaveral AFS, the PK motors would likely be off-loaded from rail cars at an existing rail spur, such as the one located on the northwest side of the station (Figure 2-9). Two mobile cranes would off-load each PK motor from the rail car to a trailer.

Just as described earlier for Vandenberg AFB, the transportation, handling, and storage requirements for rocket motors and related ordnance would be accomplished in accordance with DOD, USAF, and US DOT policies and regulations to safeguard the materials from fire or other mishap. This would include obtaining any necessary oversize/overweight hauling permits from each state where transportation would occur. A detailed transportation plan for moving MM rocket motors has been prepared (TRW, 2002). A similar plan for the shipping and handling of PK rocket motors to Cape Canaveral AFS would also be developed prior to any missions at the station that would utilize PK-derived launch vehicles.

2.1.4.3.3 Pre-Flight Preparations

Both MM and PK payloads could be processed in the Spacecraft Processing Facility. Within one of the facility clean rooms, satellites and other payloads would undergo system checks and encapsulation. If required, liquid fueling of the payload and HAPS (if used) would occur here as well.

Upon arriving at Cape Canaveral AFS, the rocket motors would likely be taken to the Integration and Processing Facility at LC-20 for storage, inspection, and booster integration. Payload processing and horizontal integration (MM-derived vehicles only) could also be conducted here.

At the selected LC, the lower and upper stack/payload assembly of a MM-derived launch vehicle would be off-loaded from a TE by crane and placed on the launch stool in a similar manner as described for SSI operations at Vandenberg AFB in Section 2.1.4.1. Motor stages and the payload assembly for PK-derived launch vehicles would also be individually stacked on the launch stool. The MSS or gantry would enclose the launch vehicle until the day of launch to provide multi-level access to the launch vehicle, and to provide environmentally controlled conditions for workers and the launch vehicle.

2.1.4.3.4 Flight Activities

When a rocket launch is planned, the booster drop zones and debris impact areas are pre-determined by the Range Safety Office using the same methods used at Vandenberg AFB (Section 2.1.4.1). Clearance areas are defined by the Range Safety Office to encompass the maximum probable distribution of debris or impact points of rocket components. Within a day prior to each launch, radar, helicopters, and other remote sensors are used to verify that the hazard areas are clear of non-mission-essential aircraft, vessels, and personnel. NOTAMs and NOTMARs would be sent out several days ahead of time. Other areas under the flight path but not in a predicted impact or debris area would be monitored before the test event to determine the location of population or traffic. If the Range Safety Office determined that the population or ship traffic was in a safe position, the test would proceed.

Should the launch vehicle head off course, leaving its predicted flight corridor, the Range Safety Officer would activate the onboard destruct package. This would stop the flight vehicle’s forward thrust, and the vehicle would fall into the ocean. This impact could occur outside cleared areas, but within a predetermined flight corridor.

2.1.4.3.5 Post-Launch Operations

After each launch, the pad and surrounding area would be inspected and any damage repaired to ready the facility for the next launch, just as described earlier for Vandenberg AFB.

As previously noted, the expended rocket motors and other vehicle hardware would not be recovered from the ocean following flight.

2.1.4.4 Wallops Flight Facility

NASA Goddard Space Flight Center`s Wallops Flight Facility, located on Virginia's Eastern Shore, is one of the oldest launch sites in the world. The facility encompasses more than 6,000 acres over three different land parcels: the Main Base, the Mainland, and the Wallops Island Launch Site. The Mainland and the Wallops Island Launch Site are located just a few miles south of the Main Base.

For the OSP, a combination of NASA and Mid-Atlantic Regional Spaceport (MARS) commercial facilities would be used to conduct launches. Two MARS-operated launch pads are located on Wallops Island Launch Site: Launch Pad 0-B (primary site) and 0-A (secondary site). Both sites are capable of supporting a variety of small- and medium-sized expendable launch vehicles. Establishment and operation of the Spaceport for launches was previously analyzed in the *Final Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center, Wallops Flight Facility, Wallops Island, Virginia* (NASA, 1997). A launch site operator license was issued in December 1997 to operate the commercial launch facility, which was later renewed in December 2002. The current launch site operator license allows the MARS to conduct up to 12 launches per year from the facility. The license requires that launches from the facility not have impacts greater than those associated with launching 12 Athena-3 vehicles.[3] Any modifications to the facility or proposed operations would require a modification to the existing launch site operator license.

Table 2-7 lists key NASA and MARS facilities that may be used in support of the OSP at Wallops Flight Facility. The locations of these facilities are also shown in Figure 2-10, along with the range of possible launch azimuths for each site.

For analysis purposes, this EA assumes that Wallops Flight Facility would be capable of launching up to two PK-derived and three MM-derived vehicles in any given year during the 10-year period for the OSP. Such launch rates, however, are unlikely to occur every year at the facility.

Table 2-7. List of Facilities Proposed to Support the OSP at Wallops Flight Facility, Virginia

Facility / Building	Activity	Site Modifications for OSP
Launch Pad 0-B [1]	Launch Site	None
Launch Pad 0-A [1]	Launch Site	Install new launch stool and refurbish multi-level vertical service tower
Hazardous Assembly/ Processing Facility (Bldg W-65)	Motor/Payload Processing	None
Hazardous Processing Facility (Bldg Y-15)	Payload Processing & Fueling	None
Payload Processing Facility	Payload Processing	None

[1] Commercial facility licensed by the FAA/AST

[3] The Athena 3 is a multi-stage launch vehicle that includes two Castor 120 solid-propellant motors and several strap-on motors. The vehicle length is about 92 ft (28 m) and it has an approximate launch weight of 323,640 lb (146,800 kg). No Athena 3 vehicles have yet been launched from Wallops Flight Facility.

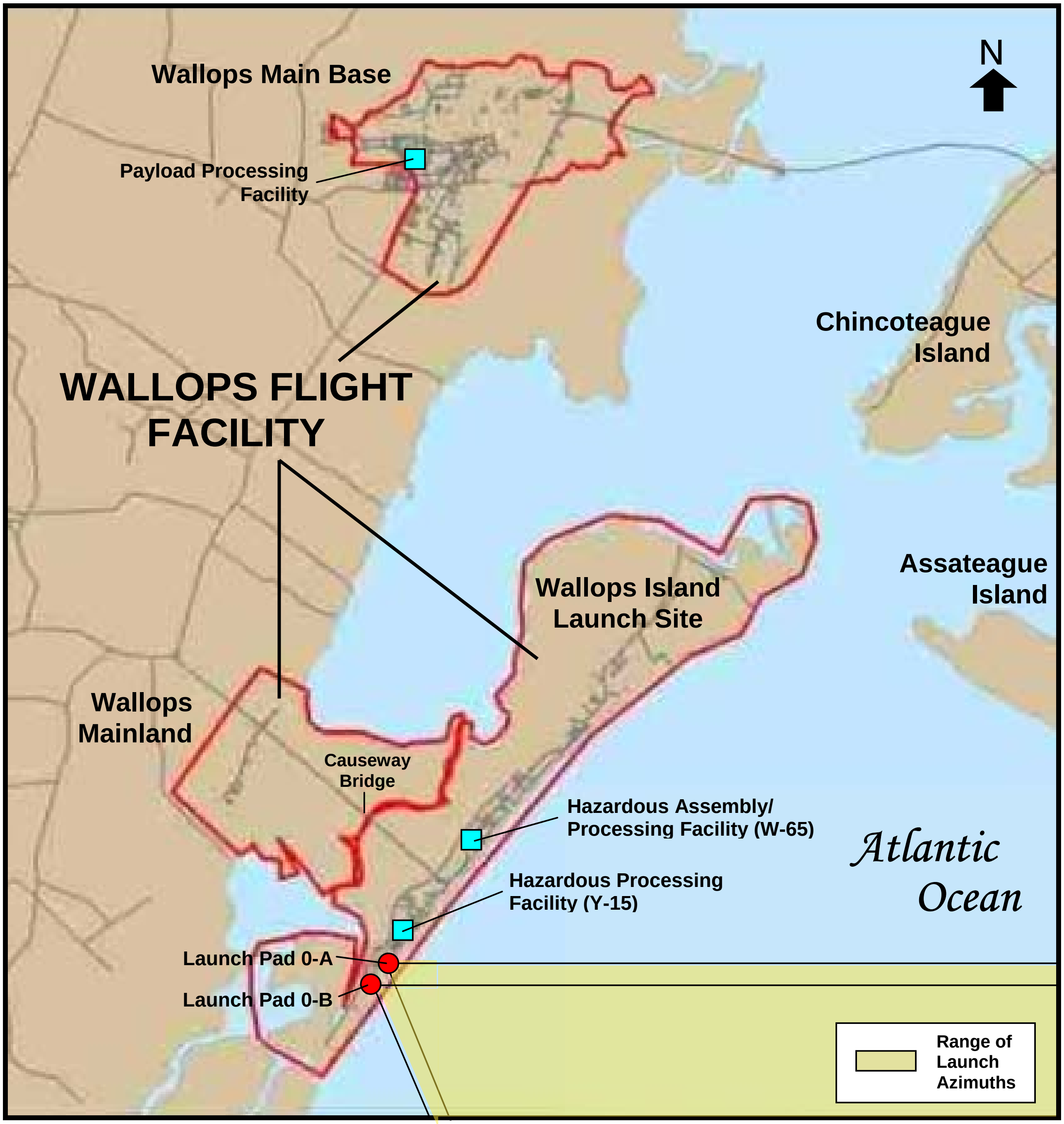


Figure 2-10. Facilities Proposed to Support the OSP at Wallops Flight Facility, Virginia

2.1.4.4.1 Site Modifications

Having recently been upgraded with a new mobile gantry, Launch Pad 0-B would not require any modifications for the OSP.

For Launch Pad 0-A to be used, the facility would require replacement of the existing launch stool, and refurbishment of the multi-level vertical service tower (gantry). The rail rollers on the mobile gantry may also need to be replaced. All facility modifications would occur on the existing concrete pad.

NASA's new Payload Processing Facility (PPF), located in the old Coast Guard housing area at Wallops Flight Facility (Figure 2-10), will eventually include two cleanroom bays: a larger bay with a 40-ton (36-metric ton) crane and a smaller bay with two 20-ton (18-metric ton) cranes. The combination of the cleanroom capability and tall hook heights will allow for the integration of sensitive payloads onto modern launch vehicles. Once completed, the OSP could utilize this facility for payload processing. The construction of the PPF was previously analyzed in the *Final Environmental Assessment for a Payload Processing Facility, National Aeronautics and Space Administration Goddard Space Flight Center, Wallops Flight Facility, Wallops Island, Virginia* (NASA, 2003a).

2.1.4.4.2 Rocket Motor Transportation

Just as described earlier for Vandenberg AFB, the first two or three stages of a MM-derived launch vehicle could be shipped from Hill AFB to Wallops Flight Facility over public roads in an MT trailer. Because of the longer travel distance to Wallops Flight Facility, an alternative would be to ship the booster to the Virginia coast in either an MT or TE trailer by rail. Smaller commercial motors for the upper stages would be either trucked or flown directly to Wallops Flight Facility, which has a runway accessible to C-141, C-17, and C-5 aircraft.

The PK motors would be shipped from Hill AFB to Wallops Flight Facility by rail whenever possible. If the motors were to be shipped by truck, a multi-axle heavy haul commercial trailer would likely be used, especially for the PK 1st-stage motor (SR-118). A Type II semi-trailer and tractor could also be used for the smaller and lighter weight PK 2nd- and 3rd-stage motors (SR-119 and SR-120, respectively). Travel would be mostly over interstate highways and would take approximately 8 to 9 days.

When shipped by rail from Hill AFB, the loaded MT or TE trailer, or individual PK motors, would be taken to a point north of Wallops Flight Facility. Because no railhead goes to the NASA facility, a transfer facility would have to be constructed several miles north of Wallops Flight Facility along an existing rail siding. This would entail construction of an off-load ramp/transfer facility at a remote location with adequate clearance from inhabited structures for satisfying applicable explosive safety requirements. The Eastern Shore Railroad, an independent line, would most likely service this facility if built. Because specific plans for the transfer facility are not yet available, construction of the facility is not analyzed further in this EA. Additional environmental analyses would be conducted, as necessary, prior to its construction.

Once delivered to the new rail transfer facility, the loaded MT or TE trailer would be rolled off the rail car and trucked south to Wallops Flight Facility. To off-load the PK 1st-stage motor, two mobile cranes would lift it from the rail car to a multi-axle heavy haul commercial trailer. Use of a commercial hauler is necessary so as not to exceed the Causeway Bridge weight limitations going from NASA's Mainland property to the Wallops Island Launch Site (Figure 2-10). Because the PK 2nd- and 3rd-stage motors are smaller and present fewer concerns over bridge-weight limitations, they can be off-loaded to a Type II transporter or commercial hauler for travel to the launch site.

For PK rocket motor travel on the local roads leading up to Wallops Flight Facility, vehicles and personnel would control traffic through narrow or curved areas where there is not enough room for two vehicles to pass. Personnel would also warn motorists of the oncoming vehicle or convoy, and transmit to the vehicle or convoy any forward anomalies. These movements would be coordinated with local police authorities.

Just as described earlier for Vandenberg AFB, the transportation, handling, and storage requirements for rocket motors and related ordnance would be accomplished in accordance with DOD, USAF, US DOT, and applicable NASA policies and regulations to safeguard the materials from fire or other mishap. This would include obtaining any necessary oversize/overweight hauling permits from each state where transportation would occur. A detailed transportation plan for moving MM rocket motors has been prepared (TRW, 2002). A similar plan for the shipping and handling of PK rocket motors to Wallops Flight Facility would also be developed prior to any missions at the facility that would utilize PK-derived launch vehicles.

2.1.4.4.3 Pre-Flight Preparations

Upon arrival at Wallops Flight Facility, the rocket motors would be transported to the Hazardous Assembly/Processing Facility (W-65) at the Wallops Island Launch Site. This facility has six bays used to store, stage, and process the rocket motors before they are moved to one of the two launch pads (0-A and 0-B).

Spacecraft and target payloads would arrive at Wallops Flight Facility via truck or military aircraft. Once unloaded, they would be placed in either the Hazardous Processing Facility (Y-15) on Wallops Island, or in the future Payload Processing Facility on the Main Base. If liquid fueling of the payload or HAPS (if used) were required, this operation would be conducted at Y-15. From either building, the payload would then be transported to W-65 for integration with the launch vehicle upper stack (MM-derived vehicles) or for payload assembly (PK-derived vehicles).

The lower and upper stack/payload assembly of a MM-derived launch vehicle would be off-loaded from a TE by mobile crane and placed on the launch stand in a similar manner as described for SSI operations at Vandenberg AFB in Section 2.1.4.1. Motor stages and the payload assembly for PK-derived launch vehicles would also be individually stacked on the launch stand, just like at Vandenberg.

2.1.4.4.4 Flight Activities

When a rocket launch is planned, the booster drop zones and debris impact areas are pre-determined by the Range Safety Office using the same methods used at Vandenberg AFB (Section 2.1.4.1). Wallops Flight Facility would coordinate its operations with the FAA, US Navy, and US Coast Guard to clear potential hazard areas. All potential impact zones within the operating areas would require clearance from the Fleet Area Control and Surveillance Facility prior to launch. This would include operating areas over the ocean, which would be surveyed for ships. Clearance with the FAA would be required for any aircraft hazard that extends beyond the operating areas. NOTAMs and NOTMARs would be issued at least 24 hours prior to launch.

A flight destruct package is required in every launch vehicle. A premature flight termination could become necessary if the vehicle guidance and control system were to malfunction, and the vehicle strayed out of its planned trajectory. Wallops Flight Facility is responsible for flight safety until all flight components have reached impact or have achieved orbital insertion.

2.1.4.4.5 Post-Launch Operations

After each launch, the pad and surrounding area would be inspected and any damage repaired to ready the facility for the next launch, just as described earlier for Vandenberg AFB.

Again, the expended rocket motors and other vehicle hardware would not be recovered from the ocean following flight.

2.1.5 FLIGHT SCENARIOS

At each of the four ranges proposed for OSP operations, clearance areas would be defined by the Range Safety Office to encompass the maximum probable distribution of debris or impact points of rocket components. Figure 2-11 depicts the typical launch and flight clearance areas. Prior to launch, all non-essential personnel would be evacuated from the Launch Hazard Area. Along the flight corridor, every practical effort would be made to keep nonparticipating aircraft and ships clear of the Safety Exclusion Zone. Though an unlikely occurrence, falling debris resulting from an in-flight malfunction or termination would impact within the Debris Limit Corridor.

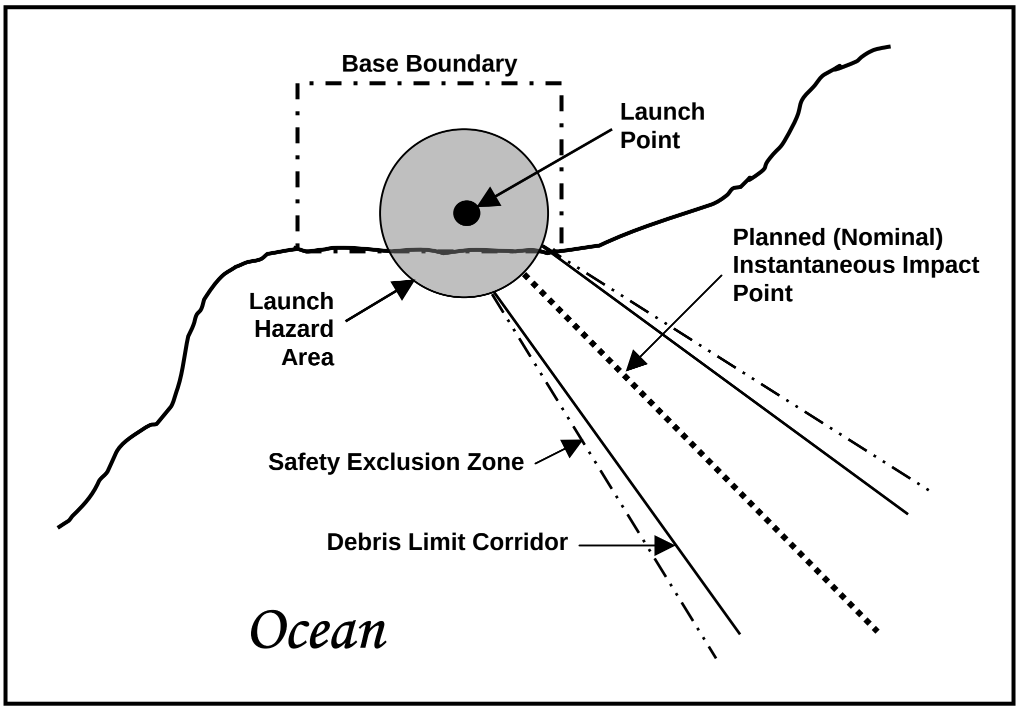


Figure 2-11. Representative Launch and Flight Clearance Areas

Although each of the ranges has numerous flight trajectory options, all or most of the expended rocket motors, sub-orbital payloads, payload shrouds, and other debris from future missions would be expected to fall within broad ocean areas following launch. No inhabited land areas would be subject to unacceptable risks of falling debris.

For launches from either the East or the West Coast, spent 1st-stage motors would typically splash down approximately 70 to 315 nmi (130 to 583 km) off the coast of the launch site. Following in sequence, the spent 2nd-stage motor—and in most cases, 3rd- and 4th-stage motors; and sub-orbital payloads (if used)—would splash down in the ocean hundreds or thousands of miles downrange. Should a land area be deliberately targeted for impact as part of a mission, additional environmental analyses separate from this EA would be conducted, as necessary.

For orbital missions, the upper-stage motors used for spacecraft orbit injection (including the HAPS, if used) could climb into space and remain in orbit following burnout, until they eventually re-enter the atmosphere sometimes days, months, or years later. Should any portions of these stages survive atmospheric reentry, the components would likely impact in the ocean, though there is a small risk for land impacts to occur.

Figures 2-12 to 2-14 show some representative rocket flight paths, booster drop zones, and terminal impact points. Shown are the planned launch of the NFIRE mission from Wallops Flight Facility, an earlier Minotaur I launch of the Joint Air Force Academy Weber State University Satellite (JAWSAT) mission from Vandenberg AFB, and a MM sub-orbital launch from Vandenberg AFB. Flight paths for other missions and from other East or West Coast launch sites would be comparable.

2.2 ALTERNATIVE ACTIONS

2.2.1 ALTERNATIVES TO THE PROPOSED ACTION

Depending on mission needs over the next 10 years, the RSLP could still meet OSP objectives through a lower level-of-activity than that described in Section 2.1 for the Proposed Action. A lower intensity of activities at one or more locations, in some cases, may also provide a meaningful reduction in potential impacts when compared to the Proposed Action. Such alternatives (modifications) to the Proposed Action could come in the form of one or more of the following:

- **Fewer Range Facilities –** Under this scenario, some launch pads or launch support facilities proposed for use at a particular range (where multiple sites are available) might not be used in support of OSP missions, because of logistical or environmental issues, mission conflicts, and/or other constraints.

- **Fewer Number of Launches –** At one or more ranges, fewer than the maximum five to six launches per year may still prove acceptable in meeting OSP mission needs. Though it is very unlikely that five or six OSP launches a year might occur at one range, the allowed maximum number of launches could be specified at a lower rate to ensure that certain levels of activities or impacts at a particular range are not exceeded over the life of the program.

- **Fewer Launch Vehicle Configurations –** The Proposed Action includes use of both MM- and PK-derived launch vehicles. Because of differing characteristics between these two launch vehicles (e.g., launch emissions, launch noise, facility construction requirements, and transportation logistics), it is possible that one of them could be excluded from use at a particular range or launch pad.

Though not analyzed separately in this EA, each of these forms of alternatives would pose less of a risk to the environment than the Proposed Action. The alternatives will be taken into consideration in determining how the Proposed Action, if selected, should be implemented in order to meet current and future mission needs.

2.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the OSP would not be implemented. However, existing missions involving the use of excess ICBM assets for target launches out of Vandenberg AFB and Kodiak Launch Complex could still be conducted, in accordance with prior NEPA analyses. In addition, use of ICBM assets for orbital launch purposes would still be considered on a case-by-case basis, with appropriate NEPA reviews.

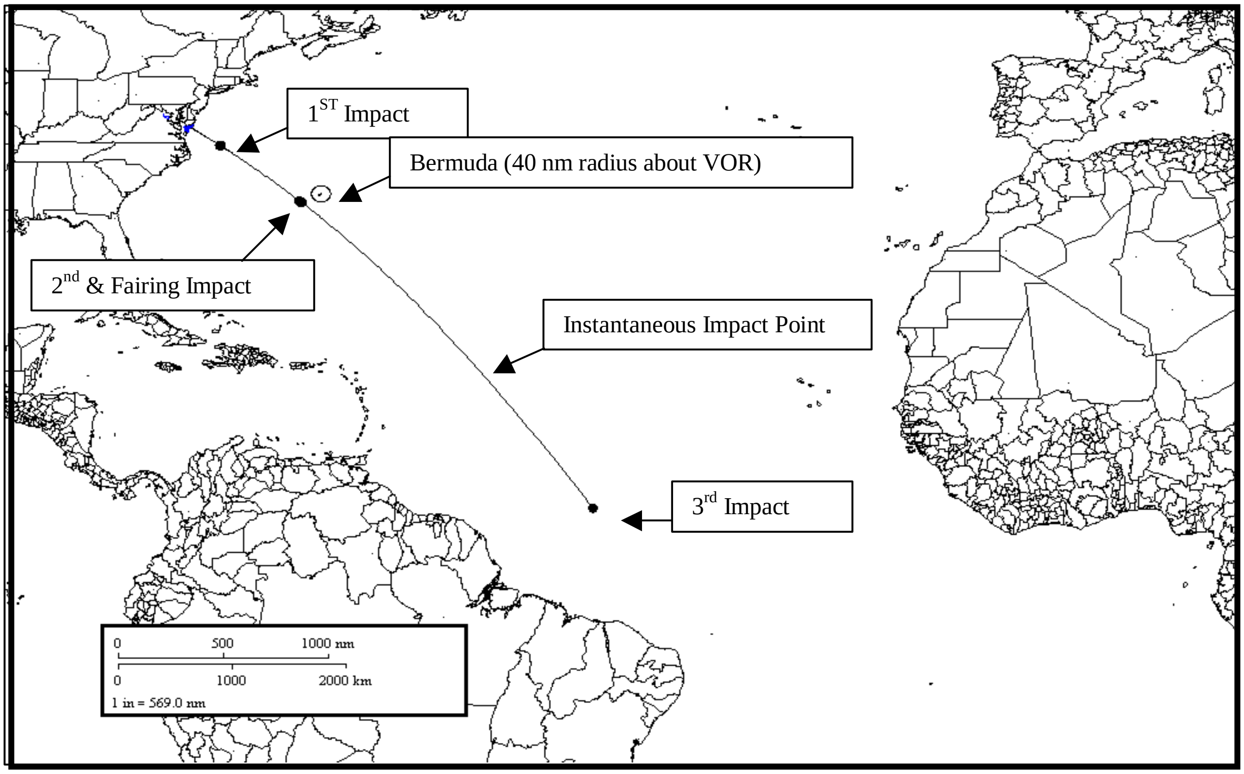


Figure 2-12. Minotaur I/II (NFIRE Mission) Flight Path from Wallops Flight Facility, Virginia

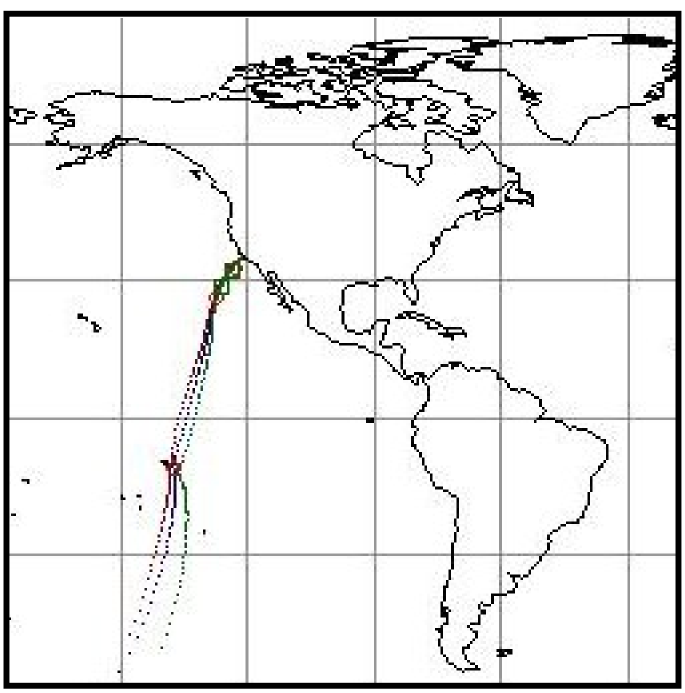


Figure 2-13. Minotaur I (JAWSAT Mission) Flight Paths from Vandenberg AFB, California

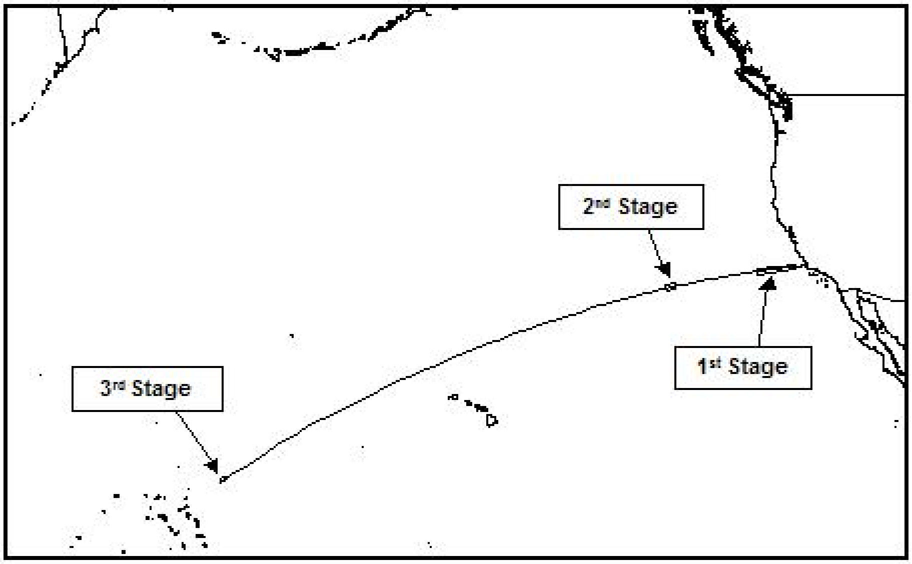


Figure 2-14. Minuteman (Sub-Orbital Mission) Flight Path from Vandenberg AFB, California

By not implementing the Proposed Action, the USAF would not be able to achieve its goal of utilizing MM and PK assets to provide a low cost and proven launch capability to deliver single and multiple payloads into orbit or to support other sub-orbital missions. Government agencies may be forced to continue utilizing other commercial launch vehicles, or larger vehicles, at a higher cost and with greater chance for mission delays. Because of these drawbacks, some RDT&E satellite programs may not be possible.

Should surplus MM and PK motors not be needed for launch purposes, they would likely be subject to disposal. Prior to taking such actions, additional NEPA analyses separate from this EA would be prepared in accordance with CEQ (2002) and USAF (2001a) regulations.

2.2.3 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Expendable launch vehicles discard boosters and other parts during flight. Because of the inherent dangers associated with these vehicles, each of the four ranges proposed for OSP operations is located either on the East or the West Coast. For this reason, other possible US launch sites, such as White Sands Missile Range in New Mexico, were eliminated from consideration because of their inland location. The Pacific Missile Range Facility, Hawaii, and the Ronald Reagan Ballistic Missile Defense Test Site in the Marshall Islands were also considered unreasonable because of excessive costs of transportation, insufficient infrastructure to support PK-derived launch vehicles, and other logistical concerns.

As described in Section 2.1.4, the USAF applied various evaluation criteria to identify potential launch sites and launch support facilities. In applying these criteria at Vandenberg AFB, the 576-E launch site, located near Purisma Point, was considered for OSP missions, but was deemed unreasonable because of technological issues. Space launches from 576-E would require OSP launch vehicles to make an abrupt turn or dogleg during flight, which would significantly reduce payload lift capability.

Also at Vandenberg, LF-05 on North Base was considered for PK-derived target launches, but was found to be unreasonable because of excessive logistical support requirements and associated costs. Conducting PK launches from the existing silo would require maintenance of the current “cold launch” system for just the one site.[4]

Though computer simulations, modeling, and other laboratory tests are typically used during the design and early evaluation of orbital and sub-orbital missions, such methods cannot provide all of the information needed to satisfy mission requirements (e.g., verify missile defense system performance). Thus, an alternative relying solely on such methods was deemed unreasonable.

2.3 COMPARISON OF ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

Table 2-8 presents a comparison of the potential environmental consequences of the Proposed Action and the No Action Alternative for those locations and resources affected. Only those resource areas subject to potential impact are addressed (see Chapter 3.0 for a rationale of resources analyzed). A detailed discussion of the potential impacts is presented in Chapter 4.0 of this EA.

2.4 IDENTIFICATION OF THE PREFERRED ACTION

The USAF’s preferred action is to implement the Proposed Action at all four ranges—Vandenberg AFB, Kodiak Launch Complex, Cape Canaveral AFS, and Wallops Flight Facility—as described in Section 2.1 of this EA. Selection of specific launch pads at Vandenberg AFB for OSP missions will be determined following public and agency review of the Draft EA, and initial agency consultations. Regarding Cape Canaveral AFS, the selection of a launch pad and other support facilities for OSP use will be determined at a later date, once OSP mission needs and facility availability have been determined. At Wallops Flight Facility, the 0-B launch pad is preferred. Depending on OSP mission needs and launch schedules, more than one launch pad could be selected at each of the ranges, except for Kodiak Launch Complex, where only Pad 1 would be used for OSP launch operations.

[4] The PK was the first (and only) US “cold launched” ICBM. Instead of igniting the main engine immediately in the silo for liftoff, a thermochemical gas generator creates pressure to eject the missile from its launch tube. The main engine ignites after the missile has cleared well above the launch tube.

Table 2-8. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
Vandenberg Air Force Base, CA		
Air Quality	Proposed demolition and construction activities at some of the launch sites would generate fugitive dust from structure removal, ground disturbance, and related operations. Although no significant amounts of emissions are anticipated, standard dust reduction measures would be implemented. Although rocket motor exhaust emissions would be released in the lower atmosphere, they would be rapidly diluted and dispersed by prevailing winds. As a result, no violation of air quality standards or health-based standards for non-criteria pollutants is anticipated. A review of the Clean Air Act (CAA) General Conformity Rule resulted in a finding of presumed conformity with the State Implementation Plan. As a result, no long-term adverse impacts are anticipated.	Although construction-related impacts associated with the Proposed Action would not occur, demolition-related impacts at Atlas and Titan Heritage program buildings and facilities could still occur. Individual projects, however, would be spread over years, short term at each building location, and standard dust reduction measures would be implemented. Short-term, launch-related impacts—similar to that of the Proposed Action—would still occur, but not as often since fewer launches would be anticipated. In addition, launch-related impacts would only occur at currently active launch.
Noise	Noise exposures from proposed demolition, modification, and construction activities on base are expected to be minimal and short term. The use of heavy construction equipment, power tools, and other machinery would generate noise levels ranging from 50 to 95 dB (unweighted) at 164 ft (50 m). If blasting of concrete structures becomes necessary during the demolition work, much higher impulse noise levels would also be generated. Such occurrences, however, would be rare. OSP launches would generate noise levels exceeding 120 dB A-weighted Sound Exposure Level (ASEL) in the immediate vicinity of the launch site, to approximately 95 dB ASEL or lower in some of the local communities. While these noise exposure levels can be characterized as very loud, they would occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and would have little effect on the Community Noise Equivalent Level off base. Launches from the SSI CLF and from either of the SLC-4 pads could generate sonic booms over the northern Channel Islands, depending on the launch trajectory used. Resulting overpressures from SSI CLF launches could reach up to 1 pound per square foot (psf) or 80 dB ASEL on the islands. For launches from the SLC-4 sites, overpressures would be higher, estimated to be between 1 and 7 psf. The sonic booms would typically be audible for only a few milliseconds, and launches over the islands are expected to occur infrequently. As a result, no significant impacts to the noise environment on and around the base would occur.	Although construction-related impacts associated with the Proposed Action would not occur, demolition-related impacts at Atlas and Titan Heritage program buildings and facilities could still occur. Individual projects, however, would be spread over years and would be short term at each building location. Short-term, launch-related impacts—similar to that of the Proposed Action—would still occur, but not as often since fewer launches would be anticipated. In addition, launch-related impacts would only occur at currently active launch sites.

Table 2-8. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
Biological Resources	Demolition and construction-related activities would generate short periods of relatively continuous noise. In rare instances, blasting of existing structures may occur, producing very brief, but high impulse noises. Noise exposures, however, would be short term and localized. Vegetation overgrowth around some unused launch sites would require clearing, and some grading and excavation would occur, mostly in pre-disturbed areas. However, limited areas would be disturbed, and vegetated areas would be surveyed for protected and other sensitive species prior to project implementation. Some of the buildings and structures proposed for demolition and/or modification are currently used as nesting and roosting sites for various bird species, including some protected under the Migratory Bird Treaty Act. A few bat species have also been found to roost in some of the buildings. To avoid impacts to these species, surveys would be conducted several months prior to project implementation, before start of the nesting season. Methods to discourage roosting and the initiation of nests would be implemented prior to demolition and facility modifications. Exposure to short-term noise from launches and helicopter overflights could cause startle effects in protected marine mammals and bird species. However, studies have shown that it is unlikely for the launch noise exposures documented to date to present a serious risk to pinniped hearing. On the basis of prior monitoring studies, it has been determined that rocket launches and helicopter overflights have a negligible impact on marine mammal populations, most sea and shore birds, and other wildlife at Vandenberg AFB. The exception has been the Federally endangered California least tern, which nests and forages at a few beaches and coastal dunes. During some prior Delta II launches at the base, a few pairs of least terns had abandoned their nests. However, OSP launches would differ from the Delta II launches in that (1) the OSP launch sites are located much further away from least tern nesting habitat, (2) there would be no OSP launch vehicle overflights of the least tern colony at Purisima Point, (3) the proposed OSP launch vehicles would generate slightly lower noise levels and for a shorter duration, and (4) no more than two OSP launches per year would occur from those launch sites closest to nesting areas. To minimize the potential for impacts on least terns, the OSP would avoid night and low-light launches, to the extent possible, from the closest launch sites. Sonic booms over the northern Channel Islands could also disturb pinnipeds, and sea and shore birds, that breed, forage, and/or rest at San Miguel and Santa Rosa Islands. However, considering the low acoustical strength of sonic booms expected from OSP launches, and the infrequency of such occurrences, no long-term effects on pinniped hearing would occur. Birds on the islands may exhibit brief flight responses, but they would not be expected to abandon nests. Launch emissions on base have the potential to acidify nearby surface waters. However, surface water monitoring conducted for larger launch systems has not shown long-term acidification of surface waters. Because the OSP launch vehicles, being smaller, produce fewer emissions, the potential for adverse effects is minimal. In addition, the constant deposition of wind blown sea salt would reduce the	Although construction-related impacts associated with the Proposed Action would not occur, demolition-related impacts at Atlas and Titan Heritage program buildings and facilities could still occur. Similar methods to minimize potential impacts on protected and other sensitive species would be implemented. Short-term, launch-related impacts—similar to that of the Proposed Action—would still occur, but not as often since fewer launches would be anticipated. In addition, launch-related impacts would only occur at currently active launch sites.

Table 2-8. Comparison of Potential Environmental Consequences

Locations and Resources Affected	Proposed Action	No Action Alternative
	acidification of surface waters. Some temporary distress to nearby vegetation from launch emissions can be expected, but no long-term adverse effects would occur. The probability for an aborted launch to occur is extremely low. If an early abort were to occur, base actions would immediately be taken for the recovery and cleanup of unburned liquid or solid propellants, and any other hazardous materials that had fallen on the beach or in shallow waters. Any propellants remaining in the offshore waters would be subject to constant wave action and currents. Thus, water circulation would, in particular, help to prevent localized build-up of perchlorate concentrations from solid propellants, which has proven to be a slow process. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, the USAF has implemented various plans and measures to limit the extent and frequency of potential impacts from launches and helicopter overflights on protected and sensitive species. In addition, monitoring of certain species during launches is conducted on a regular basis to ensure that no long-term impacts occur. As a result, no significant impacts on biological resources are anticipated, and no long-term adverse effects on threatened and endangered species or critical habitats are expected to occur.	
Cultural Resources	Several known archaeological sites are in proximity to some of the facilities proposed for demolition, modification, and construction. However, these activities would be tailored to ensure archaeological resources are avoided. Should ground disturbance activities occur near resource sites, precautionary measures (e.g., boundary testing, on-site monitoring, and fencing around resource sites) would be implemented. Base personnel and contractors would also be informed of the sensitivity of such sites. To reduce the potential for impacts, excavation and trenching operations would be limited to previously disturbed areas as much as possible. In areas where an overgrowth of vegetation must be cleared and maintained, less disturbing methods and equipment would be used (e.g., use of mowers instead of disc harrows) in order to minimize potential impacts to archaeological sites. Four facilities proposed for OSP use have been determined to be eligible for listing on the National Register of Historic Places (NRHP) for their Cold War, ICBM Program historic context. Modifications are proposed for only one of the buildings; however, a Historic American Engineering Record (HAER) of the building has already been completed. In addition, the types of activities proposed to occur in these buildings would be similar to that of the earlier MM and PK ICBM support programs. Within the ABRES-A launch complex, Building 1788 is potentially eligible for listing on the NRHP. If selected to support OSP launches, modification and use of Building 1788 would require consultation with the California SHPO, and any mitigation measures negotiated with the SHPO for such use would have to	Potential impacts to cultural resources from facility modifications and construction would not occur. However, proposed demolitions at various Atlas and Titan Heritage program buildings and facilities would still take place. Just as for the Proposed Action, precautionary actions would be implemented to avoid potential impacts to archaeological sites. None of the facilities eligible or potentially eligible for listing on the NRHP would be modified or otherwise affected. Because of fewer launches, the potential for launch-related impacts would be slightly less. In addition, launch-related impacts would only

Table 2-8. Comparison of Potential Environmental Consequences

Locations and Resources Affected	Proposed Action	No Action Alternative
	be adhered to. No impacts to archaeological sites or historic buildings are expected from nominal flight activities. However, falling debris from a flight termination or other launch anomaly could strike surface or subsurface archaeological deposits, or other cultural resources. With the potential for fires to occur, firefighting activities can also damage subsurface historic and prehistoric archaeological sites. In the unlikely event that a mishap occurs, post-mishap recommendations would include post-event surveying, mapping, photography, and site recordation to determine and record the extent of the damage. These efforts would be coordinated with applicable range representatives and the SHPO to develop the most appropriate mitigation measures based on the nature of the mishap and the cultural resources involved. As a result, no significant impacts to cultural resources are expected.	occur at currently active launch sites.
Health and Safety	Health and safety policies and procedures at the base are well developed and constantly in use. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, Government personnel, and contractors. For debris generated during each OSP launch (from liftoff through to orbit insertion), expected casualty risks for individuals on the ground would be no greater than 1 in 1,000,000, in accordance with range safety standards. Regarding rocket motor transportation over public roads, accident rates for ongoing operations have historically been very low. As a result, no significant impacts to public or occupational health and safety are anticipated.	Because of fewer launches, the potential for launch-related impacts would be slightly less.
Hazardous Materials and Waste Management	Modifications and relate demolition activities to some buildings and facilities might require surveys for asbestos, lead-based paint, and PCB ballasts if such information is not already available. Any removal of hazardous materials from the buildings and facilities would require containerizing and proper disposal at the Base Landfill or at other permitted facilities located off base. Site modifications proposed for the SLC-4 launch pads and the ABRES complexes would avoid any damage or interference with existing Installation Restoration Program (IRP) treatment and monitoring systems. The cumulative generation of solid waste from OSP-related demolition and construction activities, in addition to other planned demolitions, has the potential to exceed the permitted disposal tonnage on base. Coordination of implementation schedules for these projects, and appropriate tracking of disposal tonnages, would be needed to ensure that permitted disposal amounts at the Base Landfill are not exceeded. All hazardous materials would be managed in accordance with well-established policies and procedures. Hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. The base has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and hazardous waste handling capacities would not be exceeded, and	The demolition of multiple Atlas and Titan Heritage program buildings and facilities would still occur. The issues and impacts of removing and disposing of hazardous materials from the structures, and tracking disposal tonnages going to the Base Landfill, would essentially be the same as for the Proposed Action. Because of fewer launches, the potential for launch-related impacts would be slightly less.

Table 2-8. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
	management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.	
Kodiak Launch Complex, AK		
Air Quality	Although rocket motor exhaust emissions would be released in the lower atmosphere, they would be rapidly diluted and dispersed by prevailing winds. No violation of air quality standards or health-based standards for non-criteria pollutants is anticipated. Because Kodiak Island Borough is in full attainment with air quality standards, no CAA Conformity Determination is required. OSP activities would not jeopardize the attainment status for the region. As a result, no long-term adverse impacts are anticipated.	Short-term, launch-related impacts—similar to that of the Proposed Action—would still occur, but not as often since fewer launches would be anticipated.
Noise	OSP launches would generate a noise level exceeding 120 dB ASEL in the immediate vicinity of the launch site. Outside the complex boundaries, one ranch and the Pasagshak State Recreation Area could experience launch noise levels up to 95 dB ASEL. While these noise exposure levels can be characterized as very loud, they would occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and, for public areas, would be well within the OSHA standard of 115 dBA over 15 minutes for permissible noise exposures. Sonic booms produced by launch vehicles would occur well off the coast over ocean waters, and so are not an issue affecting coastal land areas. As a result, no significant impacts to the noise environment on and around the complex would occur.	*(Same as described above)*
Biological Resources	Exposure to short-term noise from launches could cause startle effects in protected bird species and sea otters at Narrow Cape, and pinnipeds on Ugak Island. However, biological monitoring conducted in the area and at other ranges during launches has shown little or no interruption of animal activities, nor any evidence of abnormal behavior or injury. Launch emissions have the potential to acidify nearby surface waters. However, stream testing in the area following launches has not shown any decrease in pH levels. The constant deposition of windblown sea salt in the area helps to reduce the potential for surface water acidification. As a result, no acidification of surface waters would be expected. Some temporary distress to nearby vegetation from launch emissions can be expected, but no long-term adverse effects would occur. The probability for an aborted launch to occur is extremely low. If an early abort were to occur, actions would immediately be taken for the recovery and cleanup of unburned liquid or solid propellants, and any other hazardous materials that had fallen on the ground or in any of the nearby freshwater streams and wetland areas. Any propellants remaining in the offshore waters would be subject to constant wave action and currents. Thus, water circulation would, in particular, help to prevent localized build-up of perchlorate concentrations from solid propellants, which has proven to be a slow process. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, the AADC has implemented various plans and measures to limit the extent and frequency of potential impacts on protected and sensitive species. In addition, pre- and/or post-launch surveys of certain species are	*(Same as described above)*

Table 2-8. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
	conducted for each mission to ensure that no long-term impacts occur. As a result, no significant impacts on biological resources are anticipated, and no long-term adverse effects on threatened and endangered species are expected to occur.	
Health and Safety	Health and safety policies and procedures at the complex are well developed and constantly in use. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, Government personnel, and contractors. For debris generated during each OSP launch (from liftoff through to orbit insertion), expected casualty risks for individuals on the ground would be no greater than 1 in 1,000,000, in accordance with range safety standards. Regarding rocket motor transportation over public roads, accident rates for ongoing operations have historically been very low. As a result, no significant impacts to public or occupational health and safety are anticipated.	*(Same as described above)*
Hazardous Materials and Waste Management	All hazardous materials would be managed in accordance with well-established policies and procedures. Hazardous wastes would be properly disposed of, in accordance with all Federal, state, and local regulations. The complex has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.	*(Same as described above)*
Cape Canaveral Air Force Station, FL		
Air Quality	Although rocket motor exhaust emissions would be released in the lower atmosphere, they would be rapidly diluted and dispersed by prevailing winds. No violation of air quality standards or health-based standards for non-criteria pollutants is anticipated. Because Brevard County is in full attainment with air quality standards, no CAA Conformity Determination is required. OSP activities would not jeopardize the attainment status for the region. As a result, no long-term adverse impacts are anticipated.	Short-term, launch-related impacts—similar to that of the Proposed Action—would still occur, but not as often since fewer launches would be anticipated.
Noise	OSP launches would generate noise levels exceeding 120 dB ASEL in the immediate vicinity of the launch site, to about 90 dB ASEL or lower in some of the local communities. While these noise exposure levels can be characterized as very loud, they would occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and, for public areas, would be well within the OSHA standard of 115 dBA over 15 minutes for permissible noise exposures. Sonic booms produced by launch vehicles would occur well off the coast over ocean waters and so are not an issue affecting coastal land areas. As a result, no significant impacts to the noise environment on and around the station would occur.	*(Same as described above)*
Biological Resources	Exposure to short-term noise from launches could cause startle effects in protected bird species at the station, and potentially affect other threatened and endangered species as well. However, biological	*(Same as described above)*

Table 2-8. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
	monitoring conducted in the area and at other ranges during launches has shown little or no interruption of animal activities, or any evidence of abnormal behavior, injury, or mortalities. Launch emissions have the potential to acidify nearby wetland areas. However, the deposition of wind-blown sea salt, in addition to carbonate minerals present in the soil and surface waters, would neutralize the acid from infrequent rocket emissions. As a result, little or no acidification of wetland areas or other surface waters would be expected. Some temporary distress to nearby vegetation from launch emissions can be expected, but no long-term adverse effects would occur. The probability for an aborted launch to occur is extremely low. If an early abort were to occur, actions would immediately be taken for the recovery and cleanup of unburned liquid or solid propellants, and any other hazardous materials that had fallen on the beach or in shallow waters. Any propellants remaining in the offshore waters would be subject to constant wave action and currents. Thus, water circulation would, in particular, help to prevent localized build-up of perchlorate concentrations from solid propellants, which has proven to be a slow process. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, the USAF has implemented various plans and measures to limit the extent and frequency of potential impacts on protected and sensitive species. In addition, monitoring of certain species is conducted on a regular basis to ensure that no long-term impacts occur. As a result, no significant impacts on biological resources are anticipated, and no long-term adverse effects on threatened and endangered species or critical habitats are expected to occur.	
Health and Safety	Health and safety policies and procedures at the station are well developed and constantly in use. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, Government personnel, and contractors. For debris generated during each OSP launch (from liftoff through to orbit insertion), expected casualty risks for individuals on the ground would be no greater than 1 in 1,000,000, in accordance with range safety standards. Regarding rocket motor transportation over public roads, accident rates for ongoing operations have historically been very low. As a result, no significant impacts to public or occupational health and safety are anticipated.	*(Same as described above)*
Hazardous Materials and Waste Management	Modifications to some of the existing facilities might require lead-based paint, asbestos, and/or polychlorinated biphenyl (PCB) surveys if such information is not already available. Any removal of hazardous materials from the facilities would require containerizing and proper disposal at permitted facilities. Proposed modifications at launch complexes would not disturb existing IRP sites and ongoing	Because facility modifications would not take place, the removal and disposal of hazardous materials from existing facilities would not occur and the materials would continue to be managed in place. Otherwise, impacts

Table 2-8. Comparison of Potential Environmental Consequences

Locations and Resources Affected	Proposed Action	No Action Alternative
	monitoring activities. All hazardous materials would be managed in accordance with well-established policies and procedures. Hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. The station has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.	would be the same as described above.
Wallops Flight Facility, VA		
Air Quality	Although rocket motor exhaust emissions would be released in the lower atmosphere, they would be rapidly diluted and dispersed by prevailing winds. No violation of air quality standards or health-based standards for non-criteria pollutants is anticipated. Because Accomack County is in full attainment with air quality standards, no CAA Conformity Determination is required. OSP activities would not jeopardize the attainment status for the region. As a result, no long-term adverse impacts are anticipated.	Short-term, launch-related impacts—similar to that of the Proposed Action—would still occur, but not as often since fewer launches would be anticipated.
Noise	OSP launches would generate noise levels exceeding 120 dB ASEL in the immediate vicinity of the launch site, to about 100 dB ASEL or lower in some of the local communities. While these noise exposure levels can be characterized as very loud, they would occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and, for public areas, would be well within the OSHA standard of 115 dBA over 15 minutes for permissible noise exposures. Sonic booms produced by launch vehicles would occur well off the coast over ocean waters, and so are not an issue affecting coastal land areas. As a result, no significant impacts to the noise environment on and around the facility would occur.	*(Same as described above)*
Biological Resources	Exposure to short-term noise from launches could cause startle effects in protected bird species at the facility. However, biological monitoring conducted in the area and at other ranges during launches has showed little or no interruption of animal activities, nor any evidence of abnormal behavior, injury, or mortalities. The continued presence and breeding of sea and shore birds at the facility demonstrates that rocket launches over the years have had little effect on these species. Launch emissions have the potential to acidify nearby tidal marsh wetlands and guts. However, these estuarine waters would have sufficient buffering capacity to neutralize the acid from infrequent rocket emissions. As a result, little or no acidification of wetland areas or other surface waters would be expected. Some temporary distress to nearby vegetation from launch emissions can be expected, but no long-term adverse effects would occur. The probability for an aborted launch to occur is extremely low. If an early abort were to occur, actions	*(Same as described above)*

Table 2-8. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
	would immediately be taken for the recovery and cleanup of unburned liquid or solid propellants, and any other hazardous materials that had fallen on the beach or in shallow waters. Any propellants remaining in the offshore waters would be subject to constant wave action and currents. Thus, water circulation would, in particular, help to prevent localized build-up of perchlorate concentrations from solid propellants, which has proven to be a slow process. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, NASA has implemented various plans and measures to limit the extent and frequency of potential impacts on protected and sensitive species. In addition, monitoring of certain species is conducted on a regular basis to ensure that no long-term impacts occur. As a result, no significant impacts on biological resources are anticipated, and no long-term adverse effects on threatened and endangered species or critical habitats are expected to occur.	
Health and Safety	Health and safety policies and procedures at the facility are well developed and constantly in use. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, Government personnel, and contractors. For debris generated during each OSP launch (from liftoff through to orbit insertion), expected casualty risks for individuals on the ground would be no greater than 1 in 1,000,000, in accordance with range safety standards. Regarding rocket motor transportation over public roads, accident rates for ongoing operations have historically been very low. As a result, no significant impacts to public or occupational health and safety are anticipated.	*(Same as described above)*
Hazardous Materials and Waste Management	All hazardous materials would be managed in accordance with well-established policies and procedures. Hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, and NASA regulations. The facility has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.	*(Same as described above)*
Global Environment		
Upper Atmosphere/ Stratospheric Ozone Layer	When compared to the amount of emissions released on a global scale, the OSP launches would not be statistically significant in contributing to local or cumulative impacts on the stratospheric ozone layer. Emission would be rapidly dispersed during the launch vehicle's ascent.	Impacts similar to that of the Proposed Action would still occur, but not as often since fewer launches would be anticipated.
Broad Ocean Area/ Marine Life	Sonic boom overpressures from launch vehicles could be audible to protected marine species and sea turtles underwater. An underwater acoustic pulse of 178 dB (referenced to 1 µPa) is considered the lower limit for inducing behavioral reactions in marine mammals (cetaceans), while 218 dB (referenced to 1 µPa) is considered the lower limit for inducing temporary threshold shift (TTS) in marine mammals and sea turtles. The sonic booms generated during ascent of OSP launch vehicles are expected to result	Impacts similar to that of the Proposed Action would still occur, but not as often since fewer launches would be anticipated. In addition, impacts are more likely to occur in the Pacific

Table 2-8. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
	in underwater pressures less than 140 dB (referenced to 1 μPa). On their descent to the ocean surface at the terminal end of each flight, sub-orbital target payloads will also cause sonic booms, which will generate peak underwater pressures ranging from 117 to 176 dB (referenced to 1 μPa). Thus, the resulting pressures from sonic booms would fall below the lower limits for inducing behavioral reactions, and well below the TTS threshold. For marine animals, the potential exists for direct contact or exposure to underwater shock/sound waves from the splashdown of spent rocket motors and sub-orbital target payloads. However, the likelihood for protected marine mammals or sea turtles to be located in close proximity to the impact points is extremely low. OSP launches would occur only a few times per year, and impacts from each flight likely would not occur at the same locations. Residual amounts of battery electrolytes, hydraulic fluid, and propellant materials in the spent rocket motors could lead to the contamination of seawater. However, the risk of marine life coming in contact with, or ingesting, toxic levels of solutions is not considered significant because of the rapid dilution of any contaminants; and the rapid sinking of any contaminated components to depths that are out of reach for marine mammals, sea turtles, and most other marine life. In summary, OSP launches would have no discernible effect on the ocean's overall physical and chemical properties. There would be minimal risk of launch vehicle components hitting or otherwise harassing marine mammals and sea turtles within the open ocean. Moreover, such activities would have no discernible effect on the biological diversity of either the pelagic or benthic marine environment. Consequently, no threatened and endangered marine mammals or sea turtles are likely to be adversely affected, nor would other biological resources within the open ocean be significantly impacted.	Ocean than the Atlantic because of the launch sites used.
Orbital and Re-entry Debris	The probability that OSP mission spacecraft in LEO would collide with medium- and large-size debris over their functional lifetimes is considered low. Moreover, OSP missions would be conducted and timed to avoid any possible impact or collision with the International Space Station and other manned missions, as part of normal operations. Accordingly, no significant impacts to the orbital debris population are expected. Because casualty risks for re-entry debris from all injection stage motors, and from all or most OSP orbital mission payloads (spacecraft), would be within DOD guidelines (expected casualty risk levels no greater than 1 in 10,000), and that no casualties from re-entry debris have been reported over the last 40 years, no significant impacts from re-entry debris are expected to occur.	Similar impacts to that of the Proposed Action would occur, but to a lesser degree since there would be fewer orbital missions.

3.0 AFFECTED ENVIRONMENT

This chapter describes the environmental resources at the installations and other locations identified in the Proposed Action—Vandenberg AFB, Kodiak Launch Complex, Cape Canaveral AFS, and Wallops Flight Facility, in addition to key aspects of the global environment. The chapter is organized by installation/ location, describing each environmental resource or topical area that could potentially be affected at that site by implementing the Proposed Action. The information and data presented are commensurate with the importance of the potential impacts in order to provide the proper context for evaluating impacts. Sources of data used and cited in the preparation of this chapter include available literature (such as EAs, EISs, and other environmental studies), installation and facility personnel, and regulatory agencies.

In conducting OSP activities at the four ranges, air quality, noise, biological resources, cultural resources (at Vandenberg AFB only), health and safety, and hazardous materials and waste management (including pollution prevention) are the only areas of concern requiring discussion. Surface water quality was also included in the analysis, from the standpoint of potential impacts on vegetation and wildlife. No other environmental resource areas are analyzed further at these locations because of the following reasons. The Proposed Action is expected to require minimal ground-disturbing activities; therefore, no impacts to archaeological resources (with the possible exception of recorded sites at Vandenberg AFB) or soils would be expected. Except for Cold War Era facilities located at Vandenberg AFB, there would be no modifications or changes in the current use of any historical facilities listed or eligible for listing on the NRHP, including those that are part of the Man in Space Program at Cape Canaveral AFS. Installation Restoration Program (IRP) studies have not shown any long-term concerns for contamination to soils and groundwater from repeated launches of MM and PK systems (VAFB, 2003c). There would be little or no increase in personnel on base; thus, there are no socioeconomic concerns. Given the launch trajectories of the proposed OSP missions, the protection provided by range safety regulations and procedures, and the occurrence of launch noise over a wide area of the local community, there would be no disproportionate impacts to minority populations and low-income populations under Executive Order 12898 (Environmental Justice). With the ability for each range to schedule restricted airspace over the launch site and over-ocean launch corridor, there would be little concern for potential impacts on airspace during the proposed OSP launches. The proposed launches represent activities that are within the limits of current operations and permits at each range. As a result, there would be no adverse effects on land use, utilities, or transportation.

Because of the potential global effects of launching rockets over the oceans and through the earth's atmosphere to orbit, this EA also considers the environmental effects on the global environment in accordance with the requirements of Executive Order 12114. Specifically, potential impacts on the upper atmosphere and stratospheric ozone layer, and on marine life in the Broad Ocean Area (BOA), are considered. In addition, safety-related issues associated with orbital debris and debris re-entry are discussed.

The information contained in this Chapter serves as an essential part of the baseline against which the predicted effects of the Proposed Action can be compared. The potential environmental effects of the Proposed Action and No Action Alternative are discussed in Chapter 4.0.

3.1 VANDENBERG AIR FORCE BASE

Vandenberg AFB is located in Santa Barbara County on the central coast of California, about 150 mi (240 km) northwest of Los Angeles. Covering more than 98,000 acres (39,660 hectares), it is the third largest USAF installation. A primary mission for the base is to conduct and support space and missile launches.

With its location along the Pacific coast, Vandenberg AFB is the only facility in the United States from which unmanned Government and commercial satellites can be launched into polar orbit, and where land-based ICBMs can be launched to verify weapon system performance.

3.1.1 Air Quality

In California, air quality is assessed on both a county and a regional basis. Air quality at Vandenberg AFB is regulated by the Santa Barbara County Air Pollution Control District (SBCAPCD), the California Air Resources Board (CARB), and Region IX of the US Environmental Protection Agency (USEPA). Stationary sources of air emissions on base (including both point and area sources) typically include abrasive blasting operations, boilers, generators, surface coating operations, turbine engines, wastewater treatment plants, storage tanks, aircraft operations, soil remediation, launch vehicle fueling operations, large aircraft starting system, and solvent usage. Mobile sources at the base that result in air emissions include various aircraft, missile and spacecraft launches, and numerous Government and personal motor vehicles. (VAFB, 2000a)

For analysis purposes, the Region of Influence (ROI) for inert air pollutants (all pollutants other than ozone and its precursors) is generally limited to an area extending no more than a few miles downwind from the source. The ROI for ozone and its precursors, however, may extend much further. Consequently, the overall air quality ROI includes Santa Barbara County and the immediate offshore area.

The Federal Clean Air Act (CAA) authorizes the USEPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health. Standards for seven criteria pollutants [i.e., ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than or equal to 10 micrometers (PM_{10}), particulate matter less than or equal to 2.5 micrometers ($PM_{2.5}$), and lead particles] have been adopted. Table 3-1 shows ambient concentrations of the criteria pollutants as measured by monitoring stations located near the southern end of Vandenberg AFB and in the nearby community of Santa Maria. The CARB classifies areas of the state that are in attainment or nonattainment for the California Ambient Air Quality Standards (CAAQS). Both the USEPA and CARB have designated Santa Barbara County as being in attainment of the NAAQS and CAAQS for CO, NO_2, and SO_2. As the data in Table 3-1 demonstrates, the county area is in attainment with the Federal PM_{10} standard, but has been designated by the CARB to be in nonattainment with the more stringent California standard for PM_{10}. Although Federal and state standards for $PM_{2.5}$ have been set, an attainment status for Santa Barbara County has not been determined because of insufficient data. Santa Barbara County as a whole does not meet the state ozone standard and has only recently, and by a small margin, attained the Federal ozone standard. (California ARB, 2005; SBCAPCD, 2005)

In addition to the seven criteria pollutants previously discussed, California state standards also exist for sulfates, hydrogen sulfide, vinyl chloride (chloroethene), and visibility reducing particles. Santa Barbara County is in attainment for all four of these pollutants. (SBCAPCD, 2005)

Annual emissions, the quantity of pollutants released into the air during a year, normally are estimated from the amounts of material consumed or product produced. Most emissions estimates are provided to the USEPA by state environmental agencies. Some estimates are for individual sources, such as factories, and some estimates are county totals for classes of sources, such as vehicles. Emission estimates for individual sources are based on their normal operating schedule, and take into account the effects of installed pollution control equipment and of regulatory restrictions on operating conditions (USEPA, 2004b). Table 3-2 provides information on criteria air pollutant emissions for Santa Barbara County in

Table 3-1. Air Quality Standards and Ambient Air Concentrations At or Near Vandenberg AFB, California

Pollutant	2000		2001		2002		California Standards[1]	Federal Standards[2]	
	South VAFB	Santa Maria	South VAFB	Santa Maria	South VAFB	Santa Maria		Primary[3]	Secondary[4]
Ozone (ppm)									
1-hour highest[5]	0.081	0.066	0.079	0.064	0.084	0.065	0.09	0.12	Same as Primary Standard
1-hour 2nd highest	0.078	0.065	0.076	0.063	0.079	0.064	-	-	-
8-hour highest[6]	0.069	0.058	0.070	0.058	0.078	0.059	-	0.08	Same as Primary Standard
8-hour 2nd highest	0.064	0.057	0.065	0.053	0.067	0.049	-	-	-
CO (ppm)									
1-hour highest	1.0	4.0	0.7	3.5	1.3	3.1	20	35	-
1-hour 2nd highest	0.7	3.3	0.7	2.8	1.1	2.4	-	-	-
8-hour highest	0.5	2.1	0.6	1.3	0.8	1.2	9	9	-
8-hour 2nd highest	0.5	1.9	0.6	1.1	0.6	1.2	-	-	-
NO_2 (ppm)									
1-hour highest	0.033	0.049	0.049		0.014	0.052	0.25	-	-
1-hour 2nd highest	0.028	0.048	0.047	*(no data)*	0.009	0.048	-	-	-
Annual Arithmetic Mean	0.003	0.010	0.003		0.003	0.011	-	0.053	Same as Primary Standard
SO_2 (ppm)									
1-hour highest	0.004		0.004		0.006		0.25	-	-
1-hour 2nd highest	0.004		0.003		0.006		-	-	-
3-hour highest	0.002	*(no data)*	0.002	*(no data)*	0.002	*(no data)*	-	-	0.50
3-hour 2nd highest	0.002		0.002		0.002		-	-	-
24-hour highest	0.001		0.001		0.001		0.04	0.14	-
24-hour 2nd highest	0.001		0.001		0.001		-	-	-
Annual Arithmetic Mean	0.001		0.001		0.001		-	0.03	-

Table 3-1. Air Quality Standards and Ambient Air Concentrations At or Near Vandenberg AFB, California

Pollutant	2000		2001		2002		California Standards[1]	Federal Standards[2]	
	South VAFB	Santa Maria	South VAFB	Santa Maria	South VAFB	Santa Maria		Primary[3]	Secondary[4]
PM_{10} (μg/m^3)									
24-hour highest	48	53	45	66	50	48	50	150	Same as Primary Standard
24-hour 2nd highest	42	53	44	56	45	40	-	-	-
Annual Arithmetic Mean	19	26	19	27	19	24	20	50	Same as Primary Standard
$PM_{2.5}$ (μg/m^3)									
24-hour highest		28.7		43.2		21.3	-	65	Same as Primary Standard
24-hour 2nd highest	*(no data)*	19.3	*(no data)*	23.4	*(no data)*	19.4	-	-	-
Annual Arithmetic Mean		9.77		10.40		9.52	12	15	Same as Primary Standard

Notes:

[1] California standards for ozone, carbon monoxide, sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, and particulate matter are not to be exceeded values.

[2] National averages (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with a maximum hourly average concentration above the standard, is equal to or less than one.

[3] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[4] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects from a pollutant.

[5] Not to be exceeded on more than an average of 1 day per year over a 3-year period.

[6] Not to be exceeded by the 3-year average of the annual 4th highest daily maximum 8-hour average.

Sources: California ARB, 2003; Cordes, 2004; SBCAPCD, 2003; USEPA, 2003b (Note: SBCAPCD data was used when SBCAPCD and USEPA data was contradictory for the same pollutant measure.)

Table 3-2. Total Area and Point Source Emissions for Santa Barbara County, California (Criteria Air Pollutants in Tons Per Year for 1999)					
CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
157,228	27,194	14,183	6,880	7,008	28,720

Source: USEPA, 2004b

1999, the latest date for which comprehensive air data is available from the USEPA. Table 3-3 provides information on criteria air pollutant facility (point source) emissions (i.e., major stationary sources, such as large power generators) for Vandenberg AFB in 1999, the latest date for which comprehensive air data is available from the USEPA. Though no data is available on area source emissions (i.e., minor stationary sources, such as launch vehicle fueling operations), the values shown for the base are a small fraction of the county emissions. Since 1991, all new stationary sources of emissions (and modifications) at Vandenberg AFB have applied best available technology and offset emissions at a 1.2 to 1.0 ratio.

Table 3-3. Facility (Point Source) Emissions for Vandenberg AFB, California (Criteria Air Pollutants in Tons Per Year for 1999)					
CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
11	10	3	3	<1	5

Source: USEPA, 2004c

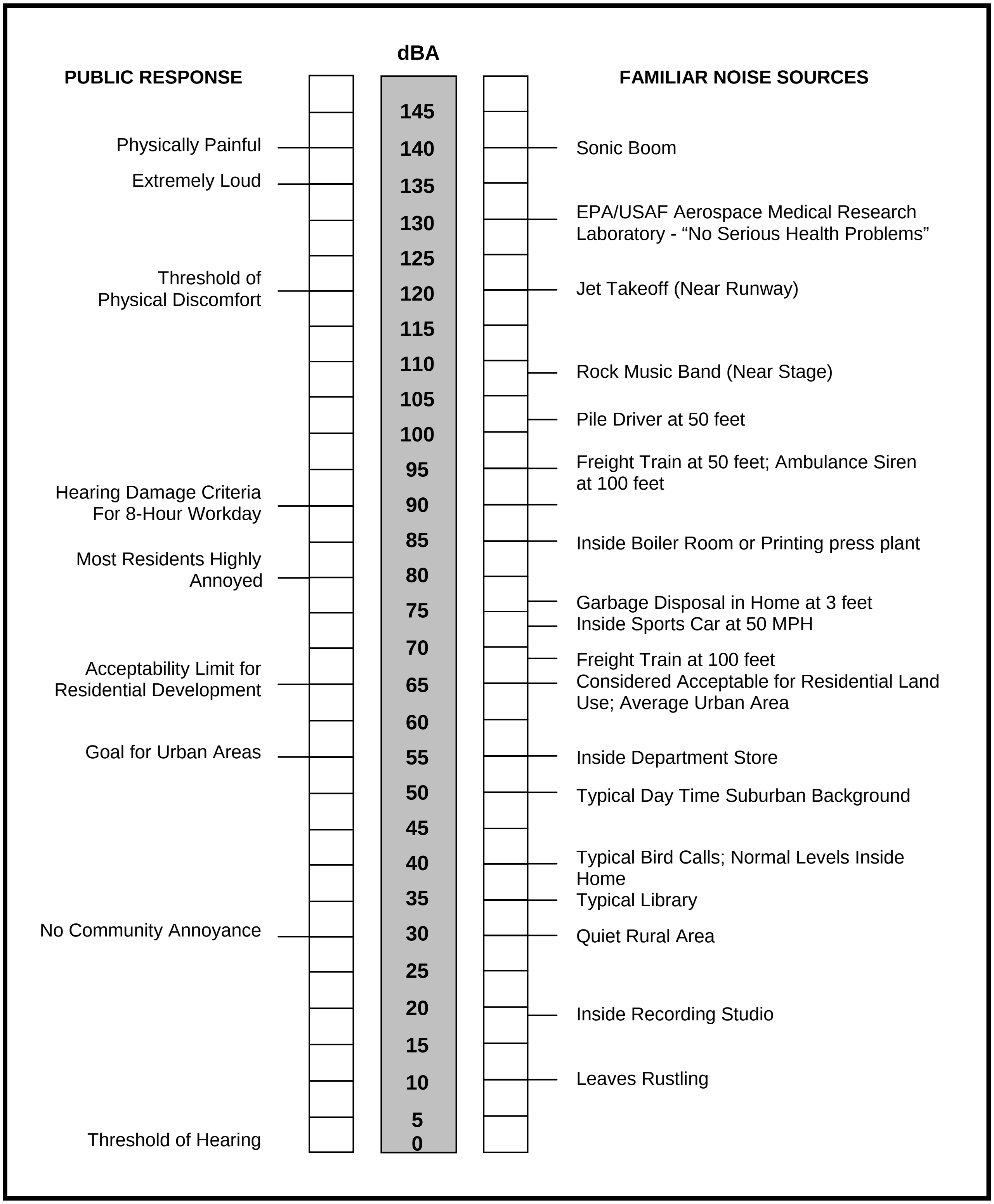
At Vandenberg AFB, wind and other meteorological conditions are critical for the dispersion of emissions. The mean annual wind speed in the area is 7 mph out of the northwest. The strongest winds occur during the winter and midday, and at ridgelines. Over half of the time, the wind blows at speeds greater than 7 mph. The entire south-central coastal region experiences a persistent subsidence inversion resulting from a Pacific high-pressure region. The average maximum daily inversion height ranges from 1,600 ft (488 m) during the summer to 2,800 ft (853 m) during the winter. (USAF, 1998)

3.1.2 NOISE

Noise is most often defined as unwanted sound that is heard by people or wildlife and that interferes with normal activities or otherwise diminishes the quality of the environment. Sources of noise may be transient (e.g., a passing train or aircraft), continuous (e.g., heavy traffic or air conditioning equipment), or impulsive (e.g., a sonic boom or a pile driver). Sound waves traveling outward from a source exert a sound pressure measured in decibels (dB).

The human ear is not equally sensitive to all sound wave frequencies. Sound levels adjusted for frequency-dependent amplitude are called "weighted" sound levels. Weighted measurements emphasizing frequencies within human sensitivity are called A-weighted decibels (dBA). Established by the American National Standards Institute, A-weighting significantly reduces the measured pressure level for low-frequency sounds, while slightly increasing the measured pressure level for some high-frequency sounds. In summary, A-weighting is a filter used to relate sound frequencies to human-hearing thresholds. Typical A-weighted sound levels measured for various sources are provided in Figure 3-1.

The greatest sound pressure level recorded during a specific period of time is termed the peak sound pressure level, further qualified as weighted or unweighted (i.e., unfiltered). Peak sound values can be



Source: Modified from USASDC, 1991

Figure 3-1. Typical Noise Levels of Familiar Noise Sources and Public Responses

too short and of such a frequency as to be missed by the human ear. Sound Exposure Level (SEL), however, is a composite cumulative energy metric comprising amplitude with duration that can be weighted or unweighted. If the SEL is A-weighted, it is referred to as ASEL, which is one of the most common metrics used for determining noise exposure effects on humans.

USAF standards currently require hearing protection whenever a person is exposed to steady-state noise of 85 dBA or more, or impulse noise of 140 dB sound pressure level or more, regardless of duration. Use of any noise hazardous machinery, or entry into hazardous noise areas, requires personal noise protection.

Air Force Occupational Safety and Health (AFOSH) Standard 161-20 and the AFI 48-20 Interim Guidance describe the USAF Hearing Conservation Program procedures used at Vandenberg AFB. Similarly, under 29 CFR 1910.95, employers are required to monitor employees whose exposure to noise could equal or exceed an 8-hour time-weighted average of 85 dBA. For off-base areas, Vandenberg AFB follows state regulations concerning noise, and maintains a Community Noise Equivalent Level (CNEL) of 65 dBA or lower. CNELs represent day-night noise levels averaged over a 24-hour period, with "penalty" decibels added to quieter time periods (i.e., evening and nighttime). As a result, the CNEL is generally unaffected by the short and infrequent rocket launches occurring locally on base.

For noise analysis purposes in this EA, the ROI at Vandenberg AFB is defined as the area within the 85-dB ASEL contours generated by proposed OSP launches. This equates to an area within a few miles of the launch sites.

Noise at Vandenberg AFB is typically produced by automobile and truck traffic, aircraft operations (approximately 32,000 per year, including landings, takeoffs, and training approaches and departures for both fixed-wing and rotary-wing aircraft), and Southern Pacific trains passing through the base (an average of 10 trains per day) (VAFB, 2000a). Existing noise levels on Vandenberg AFB are generally low, with higher levels occurring near industrial facilities and transportation routes.

The immediate area surrounding Vandenberg AFB is largely composed of undeveloped and rural land, with some unincorporated residential areas in the Lompoc and Santa Maria valleys, and Northern Santa Barbara County. The cities of Lompoc and Santa Maria, which make up the two main urban areas in the region, support a small number of industrial areas and small airports. Sound levels measured for the area are typically low, except for higher levels in the industrial areas and along transportation corridors. The rural areas of the Lompoc and Santa Maria valleys typically have low overall CNELs, normally about 40 to 45 dBA (USAF, 1998). Occasional aircraft flyovers can increase noise levels for a short period of time.

Other less frequent, but more intense, sources of noise in the region are from missile and space launches at Vandenberg AFB. These include MM III, Peacekeeper, and Delta II launches from the North Base area; and Minotaur I/II launches, and future Atlas V and Delta IV launches, from the South Base area. Depending on the launch vehicle and launch location on the base, resulting noise levels in Lompoc and Santa Maria may reach estimated maximum unweighted sound pressure levels of 100 dB and 95 dB, respectively, and have an effective duration of about 20 seconds per launch. Equivalent A-weighted sound levels would be lower. Because launches from Vandenberg AFB occur infrequently, and the launch noise generated from each event is of very short duration, the average (CNEL) noise levels in the nearby areas are not affected. (USAF, 1997b, 1998, 2000a)

Although rocket launches from Vandenberg AFB often produce sonic booms during the vehicle's ascent, the resulting overpressures are directed out over the ocean in the direction of the launch azimuth and generally do not affect the California coastline. However, some launches from South Vandenberg can cause sonic booms to occur over portions of the northern Channel Islands (USAF, 1995, 1998, 2000a).

3.1.3 BIOLOGICAL RESOURCES

For purposes of analyzing biological resources at Vandenberg AFB, the ROI includes all of the base property and near-shore waters (see Figure 3-2), and San Miguel and Santa Rosa Islands. Biological resources within deeper waters and the BOA are described in Section 3.5.2.

3.1.3.1 Vegetation

Vandenberg AFB supports a wide variety of vegetation organized according to habitat types. These include Bishop pine forest, Tanbark oak forest, coastal live oak woodland, riparian woodland, chaparral, coastal sage scrub, purple sage scrub, coastal dune scrub, coastal bluff scrub, coastal strand, grasslands, coastal bluffs, and rocky headlands. Approximately 85 percent of Vandenberg AFB vegetation is natural, with the balance either invasive vegetation that has replaced natural flora, particularly non-native annual grasslands, or plants associated with developments. Most of the vegetation around the launch facilities, particularly in areas maintained (mowed or disked) to reduce fire hazard, may be characterized as non-native grassland. (USAF, 1991b; VAFB, 2000a)

Several plants designated as Species of Concern[5] can be found on Vandenberg AFB, and are listed in Table 3-4. Habitat types and known locations on base are also identified.

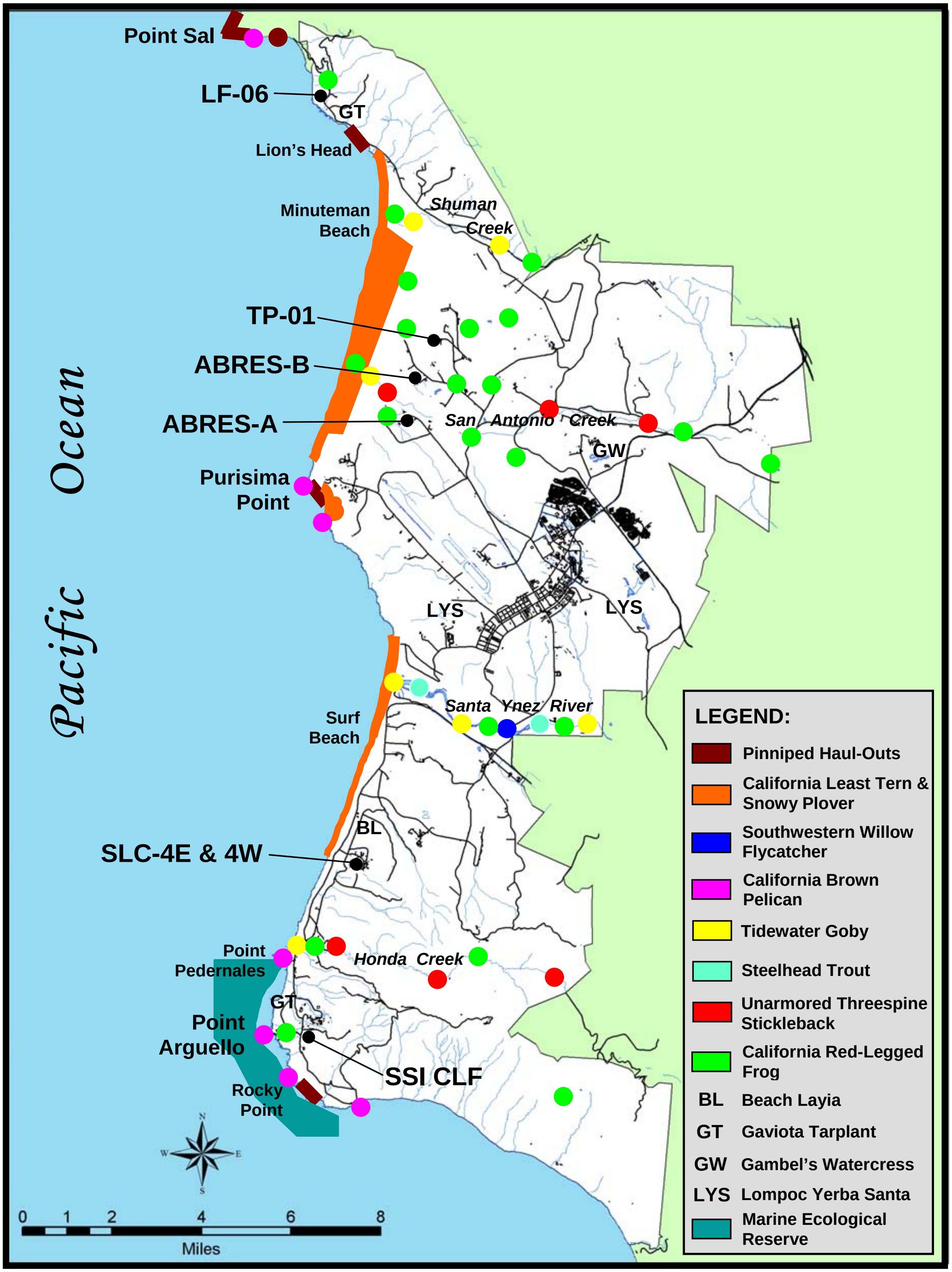
3.1.3.2 Wildlife

The various coastal environments and vegetation types found at Vandenberg AFB provide a wide range of habitats for many resident and migratory animals. While some species are associated with a specific habitat, others may be generalists, occupying multiple habitat communities. Such examples include the Western fence lizard, garter snake, brush rabbit, mule deer, Townsend's western big-eared bat, California ground squirrel, red-winged blackbird, and red-tailed hawk (USAF, 1997b, 2005; USASMDC, 2003). A number of birds and other animals found on base are designated Species of Concern. These and other protected species are listed in Table 3-4, which includes habitat types and known locations of occurrence on base.

Because Vandenberg AFB is near the southern limit of the breeding ranges for many seabird species, a long-term program was begun in 1999 to monitor population dynamics and breeding biology of seabirds breeding on the base annually. Surveys have shown the large majority of seabirds—including pigeon guillemots, pelagic cormorants, Brandt's cormorants, black oystercatchers, and western gulls—to occur around Point Arguello. Much smaller numbers of seabirds can also be found at Purisima Point and Point Sal. These and other bird species found on base, including most of those listed in Table 3-4, are given additional protections under the Migratory Bird Treaty Act. (Brown, et al., 2001; Robinette and Sydeman, 1999)

Regarding marine mammals, several species of seals and sea lions (pinnipeds) can be found within the ROI. They use beaches and rocky shores along Vandenberg AFB to rest, molt, and/or breed. Pinnipeds that may be found onshore ("hauled-out") within the ROI include the California sea lion, Pacific harbor seal, and the northern elephant seal. None of these species are listed as endangered or threatened, but all enjoy Federal protection from harassment or injury under the Marine Mammal Protection Act (MMPA). (Roest, 1995; 64 FR 9925-9932; 69 FR 5720-5728)

[5] Species of Concern status applies to plants and animals not listed under the Federal Endangered Species Act or the State-level Endangered Species Act, but for which concerns for the future well-being of the taxon exist.



Source: 67 FR 67968-68001; Collier et al., 2002; Francine, 2004, 2005; Robinette and Sydeman, 1999; Roest, 1995; UCSB, 1995; USAF, 1997b; VAFB, 2000a, 2003a

Figure 3-2. Protected Species and Sensitive Habitat at Vandenberg AFB, California

Table 3-4. Species of Concern and Other Protected Species Occurring at Vandenberg AFB, California					
Common Name	**Scientific Name**	**Federal Status**	**California Status**	**Habitat**	**Known Locations on Base**
Plants					
Black flowered figwort	*Scrophularia atrata*	-	SC	Coastal sage scrub, chaparral	Widespread on base
Aphanisma	*Aphanisma blitoides*	-	SC	Coastal bluffs	One known occurrence on base
Sand mesa (shagbark) manzanita	*Arctostaphylos rudis*	-	SC	Chaparral	Widespread on base
Straight-awned spineflower	*Chorizanthe rectispina*	-	SC	Chaparral, coastal scrub	
Dune larkspur	*Delphinium parryi* ssp *blochmaniae*	-	SC	Chaparral, coastal dunes	
Blochman's dudleya	*Dudleya blochmaniae* ssp *blochmaniae*	-	SC	Vernal pools, coastal bluffs	Occurs in 35th St. vernal pools and near Point Sal on base
Blochman's leafy daisy	*Erigeron blochmaniae*	-	SC	Coastal sand dune and hills	Last sighting on base in 1979
Kellog's horkelia	*Horkelia cuneata* ssp *sericea*	-	SC	Chaparral, coastal scrub	Widespread on base
Crisp monardella	*Monardella crispa*	-	SC	Coastal dunes	
San Luis Obispo monardella	*Monardella frutescens*	-	SC	Coastal dunes	
Fish					
Arroyo chub	*Gila orcutti*	-	SC	Streams and lakes	
Reptiles/Amphibians					
Western spadefoot toad	*Scaphiopus hammondii*	-	SC	Grassland, vernal pools	Dormant underground during dry season
Southwestern pond turtle	*Clemmys marmorata pallida*	-	SC	Perennial lakes, ponds, streams; eggs laid in upland areas near water	Hatchlings overwinter in nest; move to aquatic sites March-April
California horned lizard	*Phrynosoma coronatum frontale*	-	SC	Most habitats with loose substrates for burrowing	
Silvery legless lizard	*Anniella pulchra pulchra*	-	SC	Sparsely vegetated coastal scrub and chaparral	
Birds [1]					
Ferruginous hawk	*Buteo regalis*	-	SC	Open country	
Long-billed curlew	*Numenius americanus*	SC	SC	Beaches and coastal dunes	
Whimbrel	*Numenius phaeopus*	SC	-	Beaches and coastal dunes	
Western burrowing owl	*Speotyto cunicularia hypugea*	SC	SC	Open, dry grassland	
Loggerhead shrike	*Lanius ludovicianus*	SC	SC	Semi-open country with posts, wires, trees, scrub	

Table 3-4. Species of Concern and Other Protected Species Occurring at Vandenberg AFB, California

Common Name	Scientific Name	Federal Status	California Status	Habitat	Known Locations on Base
Bell's sage sparrow	*Amphispiza belli belli*	-	SC	Open chaparral	Associated with successional (burned) habitat
Tricolored blackbird	*Agelaius tricolor*	SC	SC	Dense tule stands, fields, and pastures	
Lawrence's goldfinch	*Carduelis lawrencei*	SC	-	Oak-pine woodland, chaparral	Shuman Creek, San Antonio Creek, and Santa Ynez River
Golden eagle	*Aquila chrysaetos*	FP	SC	Cliffs, large trees in open areas	
Ashy storm-petrel	*Oceanodroma homochroa*	SC	SC	Rock outcrops, coastal bluffs	
Western least bittern	*Ixobrychus exilis hesperis*	-	SC	Freshwater marsh, ponds, lakes with emergent vegetation	Punchbowl Lake
White-faced ibis	*Plegadis chihi*	-	SC	Freshwater marshes, ponds	Flock observed at Barka Slough
Cooper's hawk	*Accipiter cooperii*	-	SC	Wooded semi-open riparian habitats, agricultural fields	
Sharp-shinned hawk	*Accipiter striatus*	-	SC	Semi-open wooded habitats, margins of open areas	
Northern harrier	*Cicus cyaneus*	-	SC	Open grassland, coastal sage scrub, marshes, agricultural areas	
Osprey	*Pandion haliaetus*	-	SC	Lakes, ponds, sloughs, river mouths, nearshore ocean waters	
Merlin	*Falco columbarius*	-	SC	Open grassland, agricultural areas, sloughs, and beaches	
Black oystercatcher	*Haematopus bachmani*	SC	-	Rock outcrops, coastal bluffs	
Marbled godwit	*Limosa fedoa*	SC	-	Beaches and coastal dunes	
Rhinoceros auklet	*Cerorhinca monocerata*	-	SC	Rock outcrops, coastal bluffs	
California horned lark	*Eremophila alpestris actia*	-	SC	Grassland, dunes, agricultural fields	
Yellow warbler	*Dendroica petechia brewsteri*	-	SC	Willow riparian woodland	
Yellow breasted chat	*Icteria virens*	-	SC	Dense willow riparian thicket, woodland	
Black-chinned sparrow	*Spizella atrogularis*	SC	-	Scrub habitats	

Table 3-4. Species of Concern and Other Protected Species Occurring at Vandenberg AFB, California

Common Name	Scientific Name	Federal Status	California Status	Habitat	Known Locations on Base
Mammals (includes near-shore waters)					
California sea lion	*Zalophus californianus*	MMPA	-	Coastal waters and rocky shorelines	Point Sal, Point Pedernales, Point Arguello, and Rocky Point haul-out sites
Pacific harbor seal	*Phoca vitulina richardsi*	MMPA	-	Coastal waters and rocky shorelines	Most haul-out sites along the base coastline, including pupping at Lion's Head
Northern elephant seal	*Mirounga angustirostris*	MMPA	-	Coastal waters and rocky shorelines	Occasional visitor to South Base haul-out sites, including Rocky Point
Townsend's western big-eared bat	*Corynorhinus townsendii townsendii*	-	SC	Rocky outcroppings, man-made structures	Upper Honda Canyon, Swordfish Cave, and Shuman Creek
Pallid bat	*Antrozous pallidus*	-	SC	Rocky outcroppings, arid caves, man-made structures	Upper Honda Canyon, Swordfish Cave, 13th & Santa Ynez River
Western mastiff bat	*Eumops perotis californicus*	SC	SC	Caves, abandoned structures, attics, trees	
San Diego desert woodrat	*Neotoma lepida intermedia*	-	SC	Coastal sage scrub, prickly pear cactus	

Notes:

[1] Most of the bird species listed are given additional Federal-level protections under the Migratory Bird Treaty Act.

SC = Species of Concern

FP = Fully Protected

MMPA = Protected under the Marine Mammal Protection Act

Source: 69 FR 5720-5728; Francine, 2005

The Pacific harbor seal is the most common marine mammal inhabiting Vandenberg AFB, occurring year-round within the ROI at up to 19 haul-out sites along the base coastline. Purisima Point and Rocky Point are the primary haul-out sites. Lion's Head has also been documented as a haul-out, and more recently as a pupping area for a small number of seals. The highest animal counts at Lion's Head, which average 20 seals, are made between September and January during the post-breeding period. Pupping occurs from March 1 through June 30. Harbor seals are considered particularly sensitive to disturbance during this period, when the risk of mother-offspring separation is greatest. As a means of assessing potential long-term effects of launch noise on pinnipeds, Vandenberg AFB conducts biological monitoring for all launches during the harbor seal pupping season (March 1 to June 30). (69 FR 5720-5728; Roest 1995; USAF, 1998, 1999)

Less than 200 California sea lions are found seasonally on Vandenberg AFB. Sea lions may sporadically haul-out to rest when in the area to forage or when transiting the area, but generally spend little time there. They can be found in the area of Point Sal, Point Pedernales, Point Arguello, and Rocky Point. In 2003, at least 142 sea lions and 5 pups were hauled out at Rocky Point. This was the first reported occurrence of sea lions being born at Vandenberg, but it may have been a result of the El Nino conditions that existed at that time. (69 FR 5720-5728; Roest 1995)

Approximately 150 northern elephant seals may be found seasonally on Vandenberg AFB. Weaned elephant seal pups making their first foraging trips occasionally haul-out for 1 to 2 days at the base before continuing on their migration. In April 2003, approximately 88 juveniles and young adult females began to haul-out at Rocky Point to molt. (69 FR 5720-5728)

South from Vandenberg AFB, about 30 mi (48 km) off the mainland coast, the northern Channel Islands provide habitat for several protected species. San Miguel and Santa Rosa Islands, in particular, are home to breeding colonies of marine birds, with the largest colony occurring on San Miguel. Pacific harbor seals, California sea lions, northern fur seals, and northern elephant seals use the islands as haul-out, mating, and pupping areas. In the winter, as many as 50,000 individual seals and sea lions can be seen at one time on San Miguel Island. (NPS, 2004; USAF, 1998)

3.1.3.3 Threatened and Endangered Species

3.1.3.3.1 Listed Floral Species

Vandenberg AFB represents an important refuge for threatened and endangered plant species because human activities and invasive species are controlled on the base. Five Federally listed plant species known or expected to occur on base are identified in Table 3-5. The locations of most of these species are shown on Figure 3-2, and all are discussed in the following paragraphs.

The Gaviota tarplant can be found in multiple locations on base, including the vicinity of Point Sal, southeast of LF-06 within the Minuteman Launch Area, and near Point Arguello and the SSI CLF (67 FR 67968-68001; Francine, 2005; USAF, 1999; VAFB, 2000a, 2000b).

Beach layia is known to occur at only a few sites along the California coastline. It was assumed that this species was extirpated from Santa Barbara County, until recent discoveries of two occurrences on Vandenberg AFB (one is located just north of the SLC-4 launch sites). (California DFG, 2003; USAF, 1997b, 1998)

Of a dozen historical locations of Gambel's watercress in California, only three small populations remain. Two are in San Luis Obispo County, while the third is found on Vandenberg AFB. (California DFG, 2003)

Table 3-5. Threatened and Endangered Species Occurring at Vandenberg AFB, California

Common Name	Scientific Name	Federal Status	California Status
Plants			
Gaviota tarplant	*Hemizonia increscens ssp. villosa*	E	E
Beach layia	*Layia carnosa*	E	E
Gambel's watercress	*Rorippa gambellii*	E	T
Lompoc yerba santa	*Eriodictyon capitatum*	E	R
La Graciosa thistle	*Cirsium loncholepis*	E	T
Seaside bird's-beak	*Cordylanthus rigidus* ssp *littoralis*	-	E
Surf thistle	*Cirsium rhothophilum*	-	T
Beach spectacle pod	*Dithyrea maritima*	-	T
Crustaceans			
Vernal pool fairy shrimp	*Branchinecta lynchi*	T	-
Fish			
Tidewater goby	*Eucyclogobius newberryi*	E	SC
Unarmored threespine stickleback	*Gasterosteus aculeatus williamsoni*	E	E
Steelhead trout	*Oncorhynchus mykiss*	E	SC
Reptiles/Amphibians			
California red-legged frog	*Rana aurora draytonii*	T	SC
Birds			
California brown pelican	*Pelacanus occidentalis californicus*	E	E
California least tern	*Sterna antillarum browni*	E	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	E
Bald eagle	*Haliaeetus leucocephalus*	T, PD	E
Western snowy plover	*Charadrius alexandrinus nivosus*	T	SC
American peregrine falcon	*Falco peregrinus anatum*	-	E
Little willow flycatcher	*Empidonax trailii brewsteri*	-	E
Belding's savannah sparrow	*Passerculus sandwicensis beldingi*	-	E
Mammals (includes nearshore waters)			
Southern sea otter	*Enhydra lutris nereis*	T	FP

Notes:
E = Endangered FP = Fully Protected
T = Threatened SC = Species of Concern
R = Rare PD = Proposed for Delisting

Source: 67 FR 67968-68001; 69 FR 5720-5728; California DFG, 2003; Francine, 2004, 2005; USAF, 1995, 1998; USASMDC, 2003; VAFB, 2000a

The Lompoc yerba santa occurs at three sites on Vandenberg AFB, all towards the middle portion of the base. Other known sites where the plant exists are on private lands that are unprotected. Populations of the plant on base are subjected to an intensive prescribed fire program to reduce fire risks. (67 FR 67968-68001; California DFG, 2003)

Habitat for the La Graciosa thistle is typically coastal dune swale wetlands and coastal salt (brackish) marsh; however, no known locations for the species have been recorded on base (Francine, 2005).

Three state-listed plant species also occur on base: seaside bird's beak, surf thistle, and beach spectacle pod (see Table 3-5). The seaside bird's beak is found primarily in chaparral on base. All three species can be found in coastal dunes. (Francine, 2005)

3.1.3.3.2 Listed Faunal Species

Eleven Federally listed wildlife species occur within the ROI at Vandenberg AFB. Table 3-5 provides a listing of these species. Expected on-base locations for most of them are shown on Figure 3-2. Discussions on each species are provided in the paragraphs that follow.

Vernal pool fairy shrimp live in ephemeral freshwater habitats, such as natural and manmade vernal pools and swales. The species prefers pools that are relatively short-lived, 3 to 7 weeks, depending on the season. None are known to occur in running or marine waters, or in other permanent bodies of water. (Eriksen and Belk, 1999; Francine, 2005)

The tidewater goby is a benthic fish species found in shallow lagoons, tidal wetlands, and the mouths of streams, tolerating fresh or brackish water year-round. Within the ROI, it has been found along much of Shuman Creek and the Santa Ynez River. It also occurs near the mouth of San Antonio Creek, and occasionally at the mouth of Honda Creek. (Francine, 2004, 2005; USAF, 1997b, 1998)

The unarmored threespine stickleback is currently restricted to a few drainages in Central and Southern California. On Vandenberg AFB, it occurs along much of the length of San Antonio Creek and Honda Creek. (California DFG, 2003; USAF, 1998; VAFB, 2000a)

The Southern California steelhead trout occurs all along the Santa Ynez River, preferring perennial streams flowing into the ocean (Francine, 2004, 2005).

The California red-legged frog prefers freshwater ponds and streams, usually with moderately deep pools, permanent water, and dense aquatic vegetation within and along water edges. Red-legged frogs are common on Vandenberg AFB and can be found almost any place where suitable habitat exists. Within the ROI, most occurrences of the red-legged frog are along Shuman Creek, San Antonio Creek and within the scattered wetlands just to the north, the Santa Ynez River, and Honda Creek. Other occurrences include small drainages near LF-06 and the retention ponds located northwest of the SSI CLF. (Francine, 2004; USFWS, 1998, 1999b; UCSB, 1995; VAFB, 2003a, 2004a)

Three listed seabirds have been found within the ROI. The endangered California brown pelican roosts mostly along rocky shores, primarily at or near Point Sal, Purisima Point, and Point Arguello; with fewer occurrences at the mouths of Shuman Creek, San Antonio Creek, and the Santa Ynez River (Collier, et al., 2002; Francine, 2004; USAF, 1997b; VAFB, 2004a). Vandenberg AFB provides important nesting and wintering habitat for western snowy plovers. Plover nesting occurs on the coastal dunes of Minuteman Beach, and from just north of the Santa Ynez River south along Surf Beach. Nesting and chick rearing activity generally occurs between March 1 and September 30. Least terns have historically foraged and bred at several coastal locations from San Antonio Creek south to the Santa Ynez River. Breeding colonies have varied from year to year in the number of nest attempts and, for some sites, are often not active at all. Since 1978, however, a colony of least terns (ranging from 20 to 80 nesting pairs) has nested annually at Purisima Point. Least tern nesting generally occurs from April 15 through August 31. (64 FR 68508-68544; Robinette, et al., 2004; Robinette and Sydeman, 1999; USFWS, 1999a; VAFB, 2003a, 2004a)

Raptorial birds with Federal and/or state status have been found within the ROI. Preferring lakes and wetland areas, bald eagles have rarely been sighted on base, occurring only in the winter. The state-listed American peregrine falcon has historically nested on or near Vandenberg AFB in the immediate vicinity of Point Sal, Point Arguello, and Rocky Point. Recently, peregrine falcons have been observed nesting along the South Vandenberg coastline. (64 FR 46541-46558; Francine, 2004, 2005; USFW, 1999a; USAF, 1997b)

The southwestern willow flycatcher frequents the Santa Ynez River area from mid-May through July, and is known to nest there. The state-listed Belding's savannah sparrow is also expected year-round in the Santa Ynez River estuary. The little willow flycatcher, another state-listed bird, is a migrant to the area, expected to only occur in willow thickets and brushy swamps. (Francine, 2005; USAF, 1998)

The only listed marine mammal occurring at Vandenberg AFB is the Federally threatened southern sea otter, which can be observed year-round foraging and rafting within a few hundred yards of the shore anywhere kelp beds can be found. Resident breeding colonies exist at Purisima Point, and along the South Base coastline, between the Boathouse [located about 2 mi (3.2 km) east of Rocky Point] and the southern base boundary. Up to 60 otters, including pups, have been seen along the southern coastline. Semi-migratory individual otters also have been seen near Point Sal. (Francine, 2004, 2005; Friends of the Sea Otter, 2002; USFWS, 1999a)

Within the area of the northern Channel Islands, the Guadalupe fur seal (*Arctocephalus townsendi*), a Federally and state threatened species, was formerly abundant, but is now only a rare summer visitor to San Miguel Island. Federally threatened Steller sea lions (*Eumetopias jubatus*) used to breed on San Miguel Island, but are now only an occasional visitor. (NOAA, 2005; USAF, 1998)

3.1.3.4 Environmentally Sensitive and Critical Habitats

In cooperation with the US Fish and Wildlife Service (USFWS) and The Nature Conservancy, Vandenberg AFB has identified habitats for special protection under its Integrated Natural Resources Management Plan (VAFB, 1997). These and other critical habitat areas found within the ROI are summarized in the following paragraphs.

The installation contains a major southern California coastal dune system, located on North Vandenberg along Minuteman Beach, south to Purisima Point (VAFB, 2000a).

Wetlands on Vandenberg AFB are ecologically important in providing food, spawning areas, nursing grounds, and habitat for many species. Wetland types on the base include marine, estuarine, riverine, lacustrine, and palustrine. Major wetland areas on base can be found along San Antonio Creek and the Santa Ynez River. A number of small tidal wetlands occur along the Minuteman and Surf Beach shorelines. Numerous small non-tidal wetlands also exist along lesser stream drainages, and at ponds and other water-holding depressions, though some are seasonal. (VAFB, 2000a, 2004a)

Although no USFWS designated critical habitat areas have been established on base for the Gaviota tarplant and Lompoc yerba santa, Vandenberg AFB has made a commitment to develop and implement protective measures to be specified in its updated Integrated Natural Resources Management Plan that is currently in revision. These measures may include monitoring, surveys, habitat enhancement, and restoration areas (67 FR 67968-68001; VAFB, 2000a).

For western snowy plovers, the USFWS has designated critical nesting habitat along the beaches and coastal dunes of Vandenberg AFB (Figure 3-2) (64 FR 68508-68544). To better protect the snowy plovers during the nesting season, Vandenberg AFB and the USFWS have drafted a recovery plan that includes closing areas of Minuteman Beach and Surf Beach to human access (VAFB, 2004b). Beach and dune closures are currently being implemented each nesting season.

To protect and promote the growth of the least tern colony at Purisima Point, Vandenberg AFB has established a comprehensive management program for the area, which includes monitoring during the breeding season, predator management, and habitat enhancements (Robinette, et al., 2004; USFWS, 1999a).

In 1994, the State of California established the Vandenberg Marine Ecological Reserve in response to the California Marine Resources Protection Act of 1990. The reserve covers a 3-mi (4.8-km) area around Point Arguello (see Figure 3-2), and serves to provide additional protections to marine mammals and other wildlife along the California coast. (Brown, et al., 2001; VAFB, 2000a)

Most of the northern Channel Islands, including San Miguel and Santa Rosa, are afforded various protections as part of Channel Islands National Park and Channel Islands National Marine Sanctuary (NOAA, 2005; NPS, 2004).

The Sustainable Fisheries Act (Public Law 104-297) requires regional Marine Fisheries Councils to manage fisheries to ensure stability of fish populations with support from the NOAA Fisheries Service. Regional Marine Fisheries Councils prepare Fishery Management Plans (FMPs) that identify and protect the habitat essential to maintain healthy fish populations. Commercially important species are preferentially targeted. Threats to habitat from both fishery and non-fishery activities are identified and actions needed to eliminate them are recommended. In California, the Pacific Marine Fishery Council (PMFC) is responsible for identifying essential fish habitat (EFH).

Fishes of commercial importance found just within and downrange from the ROI include coastal pelagic schooling squids and fishes (Pacific sardine and mackerel, northern anchovy, and jack mackerel), groundfish (rockfish, shark, and cod), and large, highly migratory pelagic fishes (tuna, marlin, and swordfish). EFH identified by the PMFC for these species includes all marine and estuary waters from the coast of California to the limits of the Exclusive Economic Zone, the 200-mi (322-km) limit. Groundfish are the species of commercial importance found within the shallow waters off Vandenberg AFB. Eighty-three species of groundfish are identified in the FMP for this region (WPRFMC, 2003).

3.1.4 CULTURAL RESOURCES

Cultural resources include prehistoric and historic sites, structures, districts, artifacts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reason. Cultural resources are limited, nonrenewable resources whose potential for scientific research (or value as a traditional resource) may be easily diminished by actions impacting their integrity.

Numerous laws and regulations require that possible effects to cultural resources be considered during the planning and execution of Federal undertakings. These laws and regulations stipulate a process of compliance and consultation, define the responsibilities of the Federal agency proposing the action, and prescribe the relationship among other involved agencies (e.g., SHPO and the Advisory Council on Historic Preservation). In addition to NEPA, the primary laws that pertain to the treatment of cultural resources during environmental analysis are the National Historic Preservation Act (especially Sections 106 and 110), the Archaeological Resources Protection Act, the Antiquities Act of 1906, the American Indian Religious Freedom Act, and the Native American Graves Protection and Repatriation Act. Depending on the integrity and historical significance of a site or property, it may be listed or eligible for listing on the NRHP.

The term ROI is synonymous with the “area of potential effect” as defined under cultural resources regulations, 36 CFR 800.16(d). In general, the ROI for cultural resources encompasses areas requiring ground disturbance (e.g., areas of new facility/utility construction) and all buildings or structures requiring modification, renovation, demolition, or abandonment. The currently defined ROI for the Proposed Action includes construction sites on base, and any other areas where ground disturbance could occur (e.g., utility corridors and roads). In cases of launch failures, the ROI would include areas of debris clean-up, firefighting, and other required post launch-anomaly activities.

3.1.4.1 Archaeological Sites

Numerous archaeological surveys at Vandenberg AFB have identified more than 2,200 prehistoric and historic cultural sites. Prehistoric sites have included dense shell middens (refuse heaps), stone tools, village sites, stone quarries, and temporary encampments (VAFB, 2000a). Several of the existing facilities that would potentially be used for activities under the Proposed Action are located adjacent to or on known archaeological sites. These facilities and associated archaeological sites are listed in Table 3-6.

Table 3-6. Archaeological Sites in Relation to Proposed OSP Facilities at Vandenberg AFB, California

Facility	Site Characteristics	NRHP Eligibility	Proximity to Facility
TP-01	Prehistoric – Large “chipping station” flakes, tools, cores	Not Determined	West end of TP-01 fenced area overlaps the site. Construction of TP-01 placed approximately 10-15 ft (3-5 m) of fill over part of the site.
ABRES-A	Prehistoric – Three small lithic scatters and four isolate finds inside the fenced complex.	Not Determined	These sites were discovered within the fence area of the complex during a 1991 survey of the ABRES-A launch facility. Some sites show signs of disturbance from construction.
SLC-4 East and West	Prehistoric – A large resource processing and residence site.	Eligible	This extremely large site [about 590 by 2,460 ft (180 by 750 m)] lies along the western edge of SLC-4 with about 35% of the site inside of the security fence. Two other sites and two isolated artifacts were recorded within 1,320 ft (402 m) of SLC-4.
Stage Processing Facility B (Building 1833)	Prehistoric – Possible quarry site with test chert and some flakes	Not Determined	Building 1833 was constructed in the middle of this site.
Stage Storage Facility (576-F) (Building 1836)	Prehistoric – One of the sites near Building 1836 is a very large, complex site that was a seasonal residential site.	At least two of these sites are eligible as part of the San Antonio Terrace Archaeological District	Two sites are adjacent to Building 1836). Six other sites are within 1,320 ft (402 m) of the 576-F complex.
Mechanical Maintenance Facility (Building 1800)	Prehistoric – Large “chipping station” flaked stone	Not Determined	This site was inadvertently discovered during construction of Building 1800.
Rail Transfer Facility (Building 1886)	Historic – Scatter of historic artifacts possibly associated with a railroad camp or the sugar beet industry.	Not Determined	This site was discovered during construction monitoring for Building 1886. The site was on the rail approaches to the facility.

Source: Lebow and Haslouer, 2005; VAFB, 2001, 2004d

3.1.4.2 Historic Buildings and Structures

As part of the World War II effort, the US Army acquired much of the area in 1941. Named Camp Cooke, the area served as a training area for armored and infantry units. In 1950, the base was re-activated in support of the Korean War. In 1957, the USAF took over the northern 65,000 acres (26,305 hectares) of Camp Cooke and renamed it "Cooke AFB." It was later renamed Vandenberg AFB in a ceremony held on October 4, 1958.

Since the late-1950's, the base has primarily been used to develop several types of intermediate and long-range ballistic missiles, and launch both military and civilian payloads into space. A multi-year survey completed in 1996 identified more than 70 sites, complexes, and facilities that have been determined eligible for the NRHP as historic Cold War-era sites (VAFB, 1996). Table 3-7 lists the Cold War sites that have the potential to be affected by the Proposed Action.

Table 3-7. Cold War Sites Potentially Affected by OSP Activities at Vandenberg AFB, California

Facility	NRHP Eligibility	Contributing Elements
LF-06	Eligible	- Launch silo - Launcher equipment room - Launch support building - Launch facility environmental shelter
ABRES-A	Potentially Eligible	Building 1788
ABRES-B	Not Eligible	None
SLC-4 East	Not Eligible	None
SLC-4 West	Not Eligible	None
SSI Integrated Processing Facility (IPF) (Building 375)	Not Eligible	None
Missile Assembly Building (MAB) (Building 1819)	Eligible	None
Experimental Payload Facility (Building 6527)	Not Eligible	None
Missile Processing Facility-2 (Building 6816)	Not Eligible	None
Integration Refurbishment Facility (Building 1900)	Eligible	None
Rail Transfer Facility (Building 1886)	Eligible	None

Source: Palmer, 2003; VAFB, 1996

At the ABRES-A complex, Building 1788 had previously been determined to be not eligible for listing on the NRHP because of changes that were made to the gantry since the Cold War period. However, during a base-wide cultural landscape inventory conducted in 2003, new data showed that the gantry might be NRHP-eligible because of its uniqueness and the historic events that occurred there during the Cold War (Palmer, 2003).

3.1.4.3 Native Populations/Traditional Resources

At the time of sustained European contact in the early 1800's, the Vandenberg AFB area was occupied by inhabitants who spoke one of the major languages of the Chumashan branch of the Hokan language family. Several villages were located in the area that is now North Vandenberg AFB. Several Chumash-related traditional resource sites have been found at Vandenberg AFB, including villages and campsites, rock art panels, and burial grounds (USAF, 1998). However, none of these sites are within the ROI for proposed OSP activities.

3.1.5 HEALTH AND SAFETY

Regarding health and safety at Vandenberg AFB, the ROI is limited to the US transportation network used in shipping rocket motors to the base, existing base facilities supporting the OSP, off-base areas within launch hazard zones, and areas downrange along the launch vehicle's flight path. The health and safety ROI includes base personnel, contractors, and the general public.

Air Force Policy Directive (AFPD) 91-2 (*Safety Programs*) establishes the USAF's key safety policies, and also describes success-oriented feedback and performance metrics to measure policy implementation. More specific safety and safety-related DOD requirements, AFIs, and other requirements and procedures pertaining to the handling, maintenance, transportation, and storage of rocket motors, and related ordnance, are listed below:

- DOD 6055.9-STD (*DOD Ammunition and Explosives Safety Standards*)
- AFI 91-114 (*Safety Rules for the Intercontinental Ballistic Missile Systems*)
- AFI 91-202 (*The US Air Force Mishap Prevention Program*)
- Air Force Manual 91-201 (*Explosives Safety Standards*)

When radiological materials are to be carried on launch vehicles or in payloads, the type and quantity of radiological material used must comply with AFI 91-110 (*Nuclear Safety Review and Launch Approval for Space or Missile Use of Radioactive Material and Nuclear Systems*). In such cases, a nuclear safety review and approval is required prior to launch.

For the transportation of rocket components to the launch facility, interstate highways are the preferred routes, although some local and state routes may be used, depending on the destination. The health and safety of travel on US transportation corridors is under the jurisdiction of each State's Highway Patrol and DOT, and the US DOT. The USAF coordinates with each state DOT whenever the transport of hazardous missile/launch vehicle components is planned to occur.

The USAF has an excellent safety record of transporting ICBM rocket motors. For ICBM systems, approximately 500,000 road miles have been driven carrying MM and PK missiles and motors between bases and launch facilities in the field. During the height of MM ICBM Program operations, from the early 1960's to 1990, over 11,000 MM missile movements involving over 12,400 individual MM rocket motors occurred by air, rail, or road. Since 1962, there have been only three accidents associated with these movements; all of them transport truck rollover scenarios involving MM systems. In each of these cases, however, all USAF property was safely recovered and there was no damage to the environment or to human health. In a program in which the USAF transported 150 boosters between 1995 and 1997, there were no traffic incidents. No accidents or rollovers have occurred with the transport of PK systems.

At FE Warren AFB, Wyoming, for example, the accident rate for USAF vehicles within the ICBM Wing area (about 0.000002 accidents per mile driven) was shown to be nearly identical to the accident rate for the entire state. (USAF, 1992, 2000c, 2001c)

Health and safety requirements at Vandenberg AFB include industrial hygiene, which is the joint responsibility of Bio-Environmental Services and the 30th Space Wing (SW) Safety Office. These responsibilities include monitoring of worker exposure to workplace chemicals and physical hazards, hearing and respiratory protection, medical monitoring of workers subject to chemical exposures, and oversight of all hazardous or potentially hazardous operations. Ground safety includes both occupational and public safety. Both AFOSH and applicable Occupational Safety and Health Administration (OSHA) regulations and standards are used to implement safety and health requirements for all workers on base, including military personnel and contractors.

Final responsibility and authority for the safe conduct of ballistic and space vehicle operations lies with the 30 SW Commander. Establishing and managing the overall safety program is the responsibility of the 30 SW Safety Office, which ensures safety during launch operations on Vandenberg AFB.

The Air Force Space Command Manual (AFSPCMAN) 91-710 (*Range Safety User Requirements*) establishes range safety policy, and defines requirements and procedures for ballistic and space vehicle operations at Vandenberg AFB (AFSPC, 2004). Over-ocean launches must comply with DOD Directive 4540.1 (*Use of Airspace by US Military and Firings Over the High Seas*).

Prior to conducting rocket launches, all launch operations are evaluated by the 30 SW Safety Office. An evaluation is made to ensure that populated areas, critical range assets, and civilian property susceptible to damage are outside predicted impact/debris limits. This includes a review of flight trajectories and hazard area dimensions, and review and approval of destruct systems. Criteria used in determining launch debris hazard risks are in accordance with the Range Commanders Council Standard 321-02 (RCC 321-02) supplement, *Common Risk Criteria for National Test Ranges: Inert Debris* (RCC, 2002).

Atmospheric dispersal modeling is also conducted to ensure emission concentrations from each launch do not exceed certain levels outside controlled areas. In accordance with 30th Space Wing Instruction (SWI) 91-106 (*Toxic Hazard Assessments*), if hydrogen chloride launch emission cloud concentrations of 10 parts per million (ppm) or higher are predicted to cross outside the base land boundary, the launch is held until meteorological conditions improve.

A NOTMAR and a NOTAM are published and circulated in accordance with 30th SWI 91-104 (*Operations Hazard Notice*) to provide warning to personnel (including recreational users of the range space and controlled sea areas) concerning any potential impact areas that should be avoided. Resources such as radar, ground roving security forces, and/or helicopter support are used prior to operations to ensure evacuation of non-critical personnel. Nearby access roads may be closed, and nearby recreational areas may be evacuated. Jalama Beach County Park, near the southern tip of the base, is closed on average once a year, while Ocean Beach County Park, between North and South Base, is closed on average three times per year under agreement with Santa Barbara County. Also under agreement with the County, Point Sal State Beach, at the northern end of the base, is closed on average twice a year (VAFB, 2003b).

In accordance with 30th SWI 91-105 (*Evacuating or Sheltering of Personnel on Offshore Oil Rigs*), the USAF notifies oil rig companies of an upcoming launch event approximately 10 to 15 days in advance. The USAF's notification, provided through the Department of the Interior's Minerals Management Service, requests that operations on the oil rigs in the path of the launch vehicle overflight be temporarily suspended and that personnel be evacuated or sheltered.

The coordination and monitoring of train traffic passing through the base is conducted in accordance with 30th SWI 91-103 (*Train Hold Criteria*).

Vandenberg AFB possesses significant emergency response capabilities that include its own Fire Department, Disaster Control Group, and Security Police Force, in addition to contracted support for handling accidental releases of regulated hypergolic propellants and other hazardous substances.

The Vandenberg AFB Fire Department approves and maintains the business plans and hazardous material inventories prescribed by the California Health and Safety Code, which are developed by organizations assigned to or doing business on the base. Additionally, the base Fire Department conducts on-site facility inspections, as required, to identify potentially hazardous conditions that could lead to an accidental release. During launch operations, Fire Department response elements are pre-positioned to expedite response in the event of a launch anomaly. (USASMDC, 2002)

3.1.6 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

For the analysis of hazardous materials and waste management at Vandenberg AFB, the ROI is defined as those base facilities that: (1) handle and transport hazardous materials; (2) collect, store (on a short-term basis), and ship hazardous waste; and (3) are in close proximity to existing IRP sites.

Hazardous materials and waste management activities at USAF installations are governed by specific environmental regulations. For the purposes of the following discussion, the term hazardous materials or hazardous waste refers to those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC Section 9601 et seq., as amended. In general, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to the public health, welfare, or the environment when released. Regulated under the Resource Conservation and Recovery Act (RCRA), 42 USC Section 6901 et seq., hazardous waste is further defined in 40 CFR 261.3 as any solid waste that possesses any of the hazardous characteristics of toxicity, ignitability, corrosiveness, or reactivity.

AFI 32-7042 (*Solid and Hazardous Waste Compliance*) and AFI 32-7086 (*Hazardous Materials Management*) specify requirements for the development of procedures to manage hazardous materials and waste. In accordance with AFI 32-4002 (*Hazardous Materials Emergency Response Program*), each installation must also develop a hazardous materials emergency response plan and procedures; this documentation provides guidelines and instructions to prevent and respond to accidental spills of hazardous materials, including a description of appropriate prevention, control, and countermeasures. These plans and procedures also incorporate appropriate Federal, state, local, and USAF requirements regarding the management of hazardous materials and hazardous waste, including pollution prevention.

On Vandenberg AFB, Air Force organizations are required to manage hazardous materials through the base's HazMart Pharmacy. The HazMart is the single point of control and accountability for the requisitioning, receipt, distribution, issue, and reissue of hazardous materials. Hazardous materials obtained from off base suppliers are also coordinated through Vandenberg AFB's HazMart Pharmacy. Hazardous materials are inventoried and tracked using Environmental Management System software. These procedures are in accordance with the base *Hazardous Materials Management Plan* (30 SW Plan 32-7086).

The prevention, control, and handling of any spills of hazardous materials are covered under Vandenberg's *Spill Prevention, Control and Countermeasures Plan* (30 SW 32-4002-C) and *Hazardous Materials Emergency Response Plan* (30 SW Plan 32-4002-A). These plans ensure that adequate and appropriate guidance, policies, and protocols regarding hazardous material spill prevention, spill incidents, and associated emergency response are available to all installation personnel.

For hazardous waste, the base *Hazardous Waste Management Plan* (30 SW Plan 32-7043-A) describes the procedures for packaging, handling, transporting, and disposing of such wastes. If not reused or recycled, hazardous wastes are transported off base for appropriate treatment and disposal. Industrial wastewaters (including rain and wash water collected from launch pad catchments) are monitored and properly disposed in accordance with the Vandenberg AFB *Wastewater Management Plan* (30 SW Plan 32-7041-A). All hazardous wastes are managed in accordance with RCRA requirements and with California Hazardous Waste Control Laws.

The transportation of hazardous materials and waste outside the base boundaries is governed by the US DOT regulations within 49 CFR 100-199.

As for IRP-related issues at proposed launch facilities on base, significant volatile organic compound (VOC) concentrations and perchlorate have been identified in the groundwater at the "Site 8 Cluster," which includes both SLC-4E and SLC-4W. In November 2003, an interim remedial action began operation at the site for plume containment (horizontal extraction well), source reduction (vacuum enhanced groundwater extraction wells), groundwater and vapor treatment (granular activated carbon), and perchlorate treatment (ion exchange technology). Infiltration borings are used for treated groundwater discharge, and treated vapor is discharged into the atmosphere. The contaminants are the result of earlier launch operations. (Kephart, 2005)

The ABRES-A launch complex is part of the "Site 13 Cluster" for IRP activities. Analytical data gathered from groundwater at the site shows a trend from trichloroethylene (TCE) through dichloroethylene (DCE) to vinyl chloride down gradient from the Site 13 discharge area. In 2000, additional monitoring wells were added to the site to assess the extent of the VOC plume and stratification of contaminants, and to determine the breakdown products down gradient from the site. A Groundwater Treatment Study was approved in May 2003. As part of this effort, a 1.5-year study is underway to evaluate the effectiveness of hydrogen release compounds to treat chlorinated solvents in groundwater down gradient of the Site 13 Cluster. A Draft Remedial Investigation Report for the site has been prepared and submitted for agency review and comment. (Kephart, 2005)

TCE contamination in groundwater has also been found at the ABRES-B launch complex, the result of Atlas ICBM launch operations conducted in the 1960's. Designated as Site 15, the IRP site was incorporated into the Basewide Groundwater Monitoring Program in 2001. In recent years, sampling has indicated a significant increase in VOC concentrations in monitoring wells nearest San Antonio Creek. Because the leading edge of the contaminant plume is threatening the creek, the USAF approved an Interim Remedial Action at Site 15, and also recommended a phytoremediation study to determine if willows in San Antonio Creek will capture and contain the leading edge of the plume. (Kephart, 2005)

Except for SLC-4, there are no other known perchlorate contamination sites on Vandenberg AFB. However, at the request of the California Environmental Protection Agency, Central Coast Regional Water Quality Control Board, a base-wide preliminary assessment was recently initiated. The assessment will conduct a historical search and identify any likely sites for perchlorate contamination. As necessary, soil and/or groundwater sampling will be conducted at identified sites. This effort is expected to be complete in 2005. (Kephart, 2004)

Other existing hazardous waste materials that might potentially exist inside some of the older buildings proposed for OSP operations could include asbestos, lead-based paint, and fluorescent lighting ballasts containing polychlorinated biphenyls (PCBs). These types of hazardous wastes are also managed in accordance with applicable Federal, state, local, and USAF requirements. (USAF, 2005)

3.2 KODIAK LAUNCH COMPLEX

The Kodiak Launch Complex is located at Narrow Cape on Kodiak Island, about 250 mi (402 km) south of Anchorage and 25 mi (40 km) southwest of the City of Kodiak. The facility is operated by the Alaska Aerospace Development Corporation (AADC), an agency of the State of Alaska, under a launch site operator license issued by the FAA/AST. Kodiak Launch Complex provides all-weather capability for processing and launching telecommunications, remote sensing, space science, and other payloads into low earth polar and Molniya[6] orbits.

In addition to the Complex's current 3,717 acres (1,504 hectares), the AADC has authority from the Alaska Department of Natural Resources (DNR) to temporarily restrict public access to an additional 7,000 acres (2,833 hectares) of state-owned lands at Narrow Cape, on a per launch basis, for increased security (Alaska DNR, 2005).

3.2.1 AIR QUALITY

In Alaska, air quality is assessed on both a borough and a regional basis. Air quality at Kodiak Launch Complex is regulated by Alaska Department of Environmental Conservation regulations [Title 18 of the Alaska Administrative Code (AAC), Chapter 50], and Region 10 of the USEPA. The Alaska Ambient Air Quality Standards are not significantly different than the NAAQS shown earlier in Table 3-1. For analysis purposes, the ROI is Kodiak Island Borough and the immediate area offshore.

Kodiak Island Borough meets all of the Federal and state standards for the criteria pollutants (USEPA, 2004a). No ambient air quality data is available for the vicinity of Kodiak Launch Complex; the closest monitoring station is 130 mi (209 km) north (Klein, 2003).

Annual emission estimates for individual sources are based on their normal operating schedule, and take into account the effects of installed pollution control equipment and of regulatory restrictions on operating conditions (USEPA, 2004b). Table 3-8 provides information on criteria air pollutant emissions for Kodiak Island Borough in 1999, the latest date for which comprehensive air data is available from the USEPA.

Table 3-8. Total Area and Point Source Emissions for Kodiak Island Borough, Alaska (Criteria Air Pollutants in Tons Per Year for 1999)

CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
7,944	644	3,589	721	36	1,072

Source: USEPA, 2004b

Diesel-driven standby generators located at the Launch Control Center, Payload Processing Facility, and Integration and Processing Facility provide backup power at Kodiak Launch Complex. All generators at the complex have block heaters and are contained in heated enclosures. Gas particulate air emissions from launch operations include the rocket-motor exhaust plume emitted during launch and diesel

[6] A Molniya orbit is an elliptical orbit at a specific inclination (60-odd degrees), usually with the apogee above the Northern Hemisphere.

generator emissions. Table 3-9 provides estimates of the existing generator (point source) emissions at Kodiak Launch Complex. Though no data is available on area source emissions (e.g., launch vehicle fueling operations), the values shown for the facility are a small fraction of the borough emissions.

Table 3-9. Facility Emissions (Generators Only) for Kodiak Launch Complex, Alaska (Criteria Air Pollutants in Tons Per Year for 1996)

CO	NO	PM_{10}	$PM_{2.5}$	SO_2	VOC
3.81	3.04	0.15	--	--	--

Source: FAA/AST, 1996

Providing for emission dispersion, average wind speeds at Kodiak Launch Complex are 12 mph (19 kph) for most of the year, and slightly lower in the months of September and October. The winds are primarily out of the northwest blowing towards the ocean. (USASMDC, 2003)

3.2.2 NOISE

As described earlier in Section 3.1.2, the ROI for noise analysis is defined as the area or areas within the 85-dB ASEL contours generated by proposed OSP launches. This equates to an area within a few miles of the launch site.

Noise exposure limits for workers at Kodiak Launch Complex are in accordance with OSHA requirements under 29 CFR 1910.95. Few inhabited areas or other noise-sensitive receptors exist near the complex. The nearest residence to the launch site is a ranch 3.8 mi (6.1 km) away, and the Pasagshak State Recreation Area (the nearest public facility) is about 4.5 mi (7.2 km) away (USASMDC, 2003). A church camp that previously operated just outside the west complex boundary is now rented, in part, for Kodiak Launch Complex security forces. Existing noise levels in these areas are expected to be characteristic of quiet rural areas (i.e., about 30 dBA).

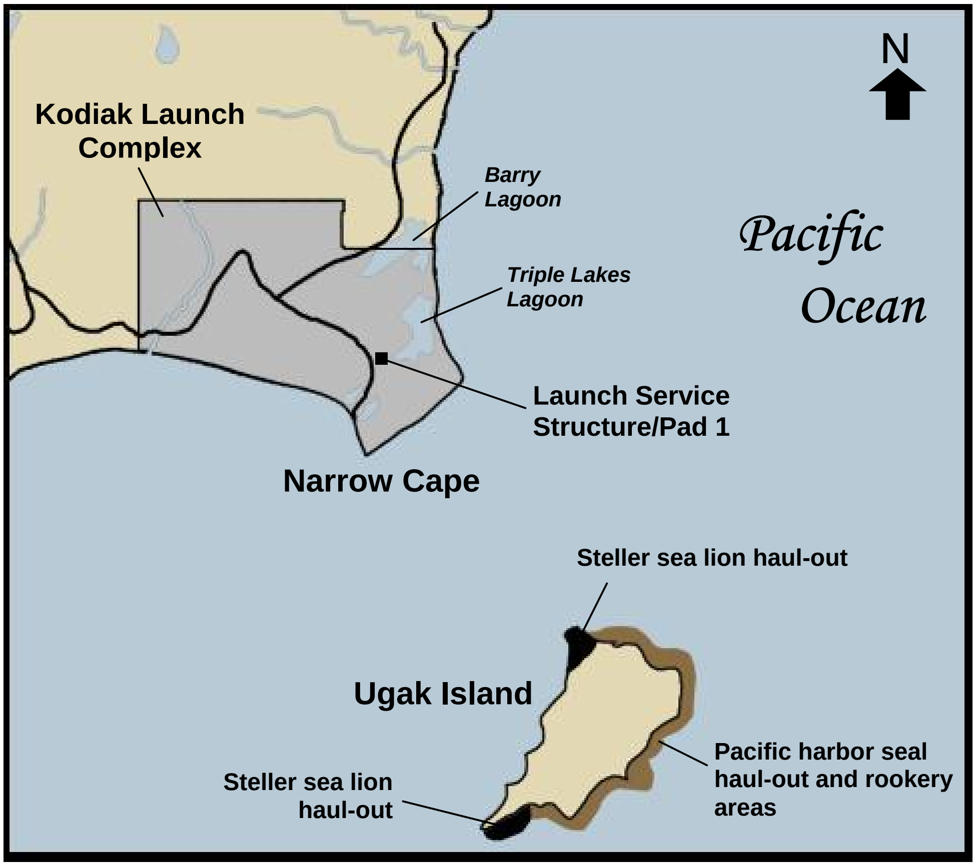
Within the Narrow Cape area, the most common man-made noise is from occasional traffic on the road from the City of Kodiak to Narrow Cape, from nearby off-road recreational vehicles, intermittent use of standby power generators at the nearby US Coast Guard LORAN Station, and the occasional rocket launch from Kodiak Launch Complex. (USASMDC, 2003)

Prior rocket launches at Kodiak Launch Complex have included the USAF atmospheric interceptor technology program, the Quick Reaction Launch Vehicle (QRLV) program, Strategic Target System, and Athena; the latter being the largest vehicle licensed to be launched from the facility. Near the northern spit of Ugak Island, about 3.5 mi (5.6 km) from the launch site, the recorded launch ASEL has ranged from 80 dB for the QRLV to 101 dB for the Athena (ENRI, 2001, 2002a).

Although rocket launches from Kodiak Launch Complex can generate sonic booms during the vehicle's ascent, the resulting overpressures are directed out over the ocean in a southerly direction, along the launch trajectory, and generally do not affect Kodiak or Ugak Islands.

3.2.3 BIOLOGICAL RESOURCES

For purposes of analyzing biological resources at Kodiak Launch Complex, the ROI is defined as the facility property and the near-shore waters, and Ugak Island (see Figure 3-3). Biological resources within deeper waters and the BOA are described in Section 3.5.2.



Source: Modified from USASMDC, 2003

Figure 3-3. Protected Species and Sensitive Habitat at Kodiak Launch Complex and Ugak Island, Alaska

3.2.3.1 Vegetation

The vegetation community structure of Narrow Cape has been previously affected by years of livestock grazing. The predominant vegetation types covering Kodiak Launch Complex include hairgrass-mixed forb (broad leaved herbs), open willow-hairgrass-mixed forb meadow, shrublands, wetlands, and intermittent stands of spruce. Some of the most common plants are hairgrass, meadow fescue, alder, willow, and Sitka spruce. To minimize fire hazards, large areas around the Launch Service Structure/ Pad 1 are kept clear of brush and trees, and are covered mostly with grass. (FAA/AST, 1996; USASMDC, 2003)

3.2.3.2 Wildlife

Fishery resources on and adjacent to Kodiak Launch Complex include freshwater, anadromous, and marine species. Because streams and lakes in the ROI are relatively small and shallow, freshwater fishery resources are limited. Coho salmon, sculpin, and stickleback have been captured or observed in streams draining from the site (AADC, 1998).

The Kodiak Launch Complex provides seasonal habitat for approximately 140 species of terrestrial and marine birds. Bird species typically found in the area include loons, grebes, harlequin ducks, kingfishers, glaucous-winged gulls, black scoters, pelagic cormorants, chickadees, juncos, and sparrows. (AADC, 1998; ENRI, 1999; USASMDC, 2003)

Though arctic and Aleutian tern colonies have historically occurred at Narrow Cape, no such colonies have been seen in the area since the mid-to-late 1980's. Aleutian terns are now only occasionally sighted on Narrow Cape. (Kelly, 2004; FAA/AST, 1996)

In 1995, the bald eagle was reclassified from endangered to threatened in the lower 48 states, but remains unlisted in Alaska. Up to 12 bald eagles have been sighted at or near Kodiak Launch Complex during prior surveys. In recent years, an active bald eagle nest has been observed at the southern tip of Narrow Cape. Indications are that a second nest might exist near the northeast corner of the Complex property. Both nest sites are located on seaside cliffs and related features (ENRI, 2002b, 2002c). One to two peregrine falcons have also been sighted in the area on occasion (ENRI, 2002a, 2002b).

The little brown bat, tundra vole, red fox, brown bear, short-tailed weasel, and river otter are common terrestrial mammals found at Kodiak Launch Complex. Other species introduced to Kodiak Island, including snowshoe hares, red squirrels, muskrats, beaver, Sitka blacktailed deer, buffalo, and mountain goats, may also occur in the area. (USASMDC, 2003)

The Narrow Cape area also supports various marine mammal species. Ugak Island, located approximately 3 mi (5 km) southeast of Kodiak Launch Complex (Figure 3-3), contains the closest harbor seal haul-out and rookery (breeding/pupping). The harbor seal is a year-round resident of the area. The northern fur seal also occurs offshore from January through April. (AADC, 1998; FAA/AST, 1996; USASMDC, 2003).

3.2.3.3 Threatened and Endangered Species

3.2.3.3.1 Listed Floral Species

No threatened or endangered plant species are found within the boundaries of the Kodiak Launch Complex (USASMDC, 2003).

3.2.3.3.2 Listed Faunal Species

There are no threatened or endangered species within the boundaries of the Kodiak Launch Complex; however, a few listed species occur within the ROI, including the near-shore waters. Table 3-10 identifies these and other protected species.

The Steller's eider, a Federally threatened species, is present only in the offshore waters near Kodiak Launch Complex during the winter months, generally mid-October through March. The locations and numbers of eiders present can fluctuate widely, depending on the time of year and weather variables (ENRI, 2002b, 2002c). The Federally and state endangered short-tailed albatross might also occur in the ROI, primarily during the summer months (USASMDC, 2003). However, no albatross sightings have been recorded during wildlife surveys conducted for launches at Kodiak Launch Complex (ENRI, 2002b, 2002c).

Along with harbor seals, Federally endangered Steller sea lions also haul-out on portions of Ugak Island, primarily from late June to early October (Figure 3-3). No sea lion rookeries, however, have been identified on Ugak (69 FR 63114-63122; FAA/AST, 1996; USASMDC, 2003).

Table 3-10. Threatened, Endangered, and Other Protected Species Occurring at Kodiak Launch Complex and Ugak Island, Alaska

Common Name	Scientific Name	Federal Status	Alaska Status
Birds			
Steller's eider	*Polysticta stelleri*	T	SC
Short-tailed albatross	*Phoebastria albatrus*	E	E
Bald Eagle	*Haliaeetus leucocephalus*	BG	-
Peregrine falcon	*Falco peregrinus*	-	SC
Mammals (haul-out sites & nearshore waters)			
Steller sea lion	*Eumetopias jubatus*	E	SC
Pacific harbor seal	*Phoca vitulina richardsi*	MMPA	-
Northern sea otter	*Enhydra lutris kenyoni*	T	SC

Notes:
E = Endangered
T = Threatened
MMPA = Protected under the Marine Mammal Protection Act
BG = Protected under the Bald and Golden Eagle Protection Act
SC = Species of Concern

Source: 70 FR 46366-46386; ADF&G, 2004; ENRI, 2002c; USASMDC, 2003

Recently listed as a Federally threatened species, a few northern sea otters (up to six animals) have been observed in recent years in near-shore waters, just off the southern and eastern tip of Narrow Cape (70 FR 46366-46386; ENRI, 2002a, 2002c, 2005).

3.2.3.4 Environmentally Sensitive and Critical Habitats

Wetlands cover approximately 29 percent of Kodiak Launch Complex and occur in almost all areas of the property. A mix of palustrine, emergent, persistent, seasonally flooded and palustrine scrub/shrub, broad-leaved deciduous, saturated wetlands can be found here.

Critical habitat for the Steller sea lion has been designated along the western side of Kodiak Island, far outside the ROI (58 FR 45269-45285). Though important, the Steller sea lion haul-out areas on Ugak Island are not part of this critical habitat.

The waters south of Kodiak Island, including the Narrow Cape vicinity, are EFH for commercially important fish species year-round. Habitat areas of particular concern include all streams, lakes, and other freshwater areas used by salmon and other anadromous fish. The closest major salmon stream to the Kodiak Launch Complex is the Pasagshak River, which is approximately 6 mi (10 km) to the northwest. The most common marine fish in the waters around Kodiak Island are flounder, sole, pollock, skate, cod, and halibut. Other common marine organisms include crabs, scallops, octopus, shrimp, and clams. (AADC, 1998; USASMDC, 2003)

3.2.4 HEALTH AND SAFETY

At Kodiak Launch Complex, the ROI for health and safety is limited to the US transportation network used in shipping rocket motors to the site, existing on-site facilities supporting the OSP, off-base areas within launch hazard zones, and areas downrange along the launch vehicle's flight path. The health and safety ROI includes AADC personnel, contractors, and the general public.

The Kodiak Launch Complex Range Safety Manual (AADC, 2003a) sets forth the range safety policy and criteria governing all launch support operations conducted at the facility, and is applicable to all AADC personnel, AADC contractors, tenants, experimenters, and range users. Health and safety procedures prescribed by the manual are in accordance with applicable DOD, Federal, and state regulations, standards, and procedures, including the following:

- DOD 6055.9-STD (*DOD Ammunition and Explosives Standards*)
- AFSPCMAN 91-710 (*Range Safety User Requirements*)
- RCC 321-02 Supplement (*Common Risk Criteria for National Test Ranges: Inert Debris*)

Similar to that described earlier for Vandenberg AFB (Section 3.1.5), these procedures provide for ground safety, flight safety, range clearance and surveillance, sea-surface area clearance and surveillance, and commercial air traffic control. They include published NOTMARs and NOTAMs, as well as coordination with the US Coast Guard and the FAA. (AADC, 2003a; USASMDC, 2003)

The Range Safety Officer (RSO) at Kodiak Launch Complex provides range safety policy guidance and direction, and operational oversight during range missions. The RSO or designee implements the measures specified in Ground and Flight Safety Plans during test range operations. A Launch Specific Safety Plan would be prepared prior to any potentially hazardous operation or launch conducted at the facility. This plan would identify the potential hazards and describe the system designs and methods employed to control the hazards. (AADC, 2003a)

The AADC determines those areas that require evacuation for each launch to ensure that the public is not exposed to unacceptable levels of risk, that physical security and safety measures can be enforced, and that adverse environmental effects are minimized. The size of the evacuation areas is based upon the potential for variability of the impact resulting from influences of local weather conditions, and small variances in the launch vehicle guidance and engineering systems. Criteria used in determining launch debris hazard risks are consistent with those employed by other national ranges. (USASMDC, 2003)

To ensure public safety during launch days, Kodiak Launch Complex security personnel would close Pasagshak Point Road and not allow unauthorized personnel to enter the Ground Hazard Area. The safety zone is under constant surveillance during the day of launch and during any hazardous operations. If the safety zone would be compromised, the launch is delayed until the area is confirmed clear. Pre-launch notifications to aviators and mariners are issued 24 hours before launch. (USASMDC, 2003)

The Kodiak Fire Department does not provide general/routine firefighting service for Kodiak Launch Complex, but will respond to wildland fires at the facility by agreement with the Alaska DNR, Division of Forestry. First line fire response at the Complex is provided by facility staff that are cross-trained in firefighting. Kodiak Launch Complex maintains and operates a pumper truck for this purpose. The Kodiak Fire Department also provides ambulance service and emergency medical response at the advanced and basic life support levels for Kodiak Launch Complex. The Kodiak Fire Marshal provides fire code enforcement, fire cause investigation, and other fire prevention services for AADC (USASMDC, 2003). The Kodiak Launch Complex Emergency Response Procedure (AADC, 2003b) details actions and responsibilities for handling various emergency situations that might occur at the facility.

In cases where radiological materials are to be carried on launch vehicles or in payloads, the type and quantity of radiological material used must comply with the applicable USAF or NASA procedures and policies (i.e., AFI 91-110 or NASA Safety Manual, NASA Procedural Requirements (NPR) 8715.3), respectively). When such materials are to be used, a nuclear safety review and approval is required.

For the transportation of rocket components to Kodiak Island, major road or rail routes would be used for ground transportation requirements to Seattle's port. The health and safety of travel on US transportation corridors is under the jurisdiction of each State's Highway Patrol and DOT, and the US DOT. The USAF coordinates with each state DOT whenever the transport of hazardous missile/launch vehicle components is planned to occur.

Once rocket motors arrive at Kodiak airport or Lash Wharf, the US Coast Guard and Alaska State Troopers would provide closure and security of the Kodiak Island road system during motor transport to Kodiak Launch Complex. The AADC would organize and control the over road convoy in accordance with established safety procedures. The City of Kodiak Fire and Police Departments provide as-needed support during these operations. (USASMDC, 2003)

3.2.5 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

For the analysis of hazardous materials and waste management at Kodiak Launch Complex, the ROI is defined as those AADC facilities that handle and transport hazardous materials; and collect, store (on a short-term basis), and ship hazardous waste.

At Kodiak Launch Complex, hazardous materials and waste are managed in adherence with the facility's Safety Policy, Emergency Response, and Contamination Control Procedures; the AADC HazCom Program; the Kodiak Area Emergency Operation Plan; and applicable state and Federal environmental laws (AADC, 2003a, 2003b; USASMDC, 2003).

Before any hazardous materials arrive at the facility, AADC is contacted to determine the proper guidelines for material handling, storage, and disposal. All contractors must provide hazardous materials information [Material Safety Data Sheet (MSDS)], label and warning signs, and a plan indicating material handling/storage procedures, spill/release prevention measures, and emergency response protocol, including cleanup and disposal procedures and first aid/medical treatment procedures. (USASMDC, 2003)

AADC is authorized to operate Kodiak Launch Complex as a Small Quantity Generator according to the Alaska Hazardous Waste Management Regulations (18 AAC 62). Pollution prevention, waste minimization, and recycling procedures are indicated in the Kodiak Launch Complex Spill Prevention Control and Countermeasures (SPCC), Emergency Response, and Contamination Control Procedures. Because no permitted hazardous waste treatment or disposal facilities exist on Kodiak Island, all hazardous waste must be shipped off site for appropriate treatment or disposal. Only licensed hazardous waste carriers may transport hazardous wastes off site. (AADC, 1998 2003a, 2003b)

As mentioned earlier, the transportation of hazardous materials and waste is governed by the US DOT regulations within 49 CFR 100-199.

There are no existing contamination and cleanup issues associated with the launch site at Kodiak Launch Complex.

3.3 CAPE CANAVERAL AIR FORCE STATION

Cape Canaveral AFS encompasses 15,800 acres (6,394 hectares) on the Canaveral Peninsula, a barrier island along the central Atlantic Coast of Florida. Located just south and east of the Kennedy Space Center (KSC), the station is well known for its early support of the Man in Space Program. Today, Cape Canaveral AFS continues to support numerous space launch missions for unmanned Government and commercial satellites, and for deep-space probes.

3.3.1 AIR QUALITY

Air quality for the Cape Canaveral AFS area is regulated under Florida Administrative Code (FAC) 62-200 *et seq*. As shown in Table 3-11, the Florida ambient air quality standards are not significantly different from the NAAQS. FAC 62-210 establishes general requirements for stationary sources of air pollutant emissions and provides criteria for determining the need to obtain an air construction or air operation permit. FAC 62-213 implements Federal rule Title 40 CFR 70, which provides a comprehensive operation permit system for permitting major sources of air pollution (Title V sources). Because station emissions are above source thresholds, the station is classified as a major source and, thus, has a Title V permit in place.

Cape Canaveral AFS is in Brevard County, which has been designated by both the USEPA and the Florida Department of Environmental Protection (DEP) to be in attainment for ozone, sulfur oxides (SO_x), nitrogen oxides (NO_x), CO, and PM_{10} (Shine, 2003; USEPA, 2004a). Table 3-11 also shows ambient air concentrations measured at nearby stations for those criteria pollutants that are monitored.

Annual emission estimates for individual sources are based on their normal operating schedule, and take into account the effects of installed pollution control equipment and of regulatory restrictions on operating conditions (USEPA, 2004b). Table 3-12 provides information on criteria air pollutant emissions for Brevard County in 1999, the latest date for which comprehensive air data is available from the USEPA.

Table 3-13 provides information on criteria air pollutant facility (point source) emissions for Cape Canaveral AFS in 1999, the latest date for which comprehensive air data is available from the USEPA. Though no data is available on area source emissions (e.g., launch vehicle fueling operations), the values shown for the station are a small fraction of the county emissions.

Stationary sources of air emissions on site typically include launch vehicle processing (including solvent cleaning and sanding activities), fueling, and other point sources such as heating/power plants, generators, incinerators, and storage tanks. Mobile sources include support equipment, commercial transport vehicles (including trucks and aircraft), rocket launches, and personal motor vehicles. (USAF, 1998)

For the dispersion of emissions, the mean annual wind speed in the vicinity of Cape Canaveral is 7 mph. The prevailing wind direction at the surface varies depending on season and sea breeze conditions, but is from the east most of the year. Under normal midday weather conditions, the surface-mixing layer averages 2,300 to 2,950 ft (701 to 899 m) during the winter, and 3,900 to 4,600 ft (1,189 to 1,402 m) during the summer. The mixed layer is rarely capped by a strong temperature inversion. (USAF, 1998)

3.3.2 NOISE

As described in Section 3.1.2, the ROI for noise analysis is defined as the area or areas within the 85-dB ASEL contours generated by proposed OSP launches. This equates to an area within a few miles of the launch site.

Table 3-11. Air Quality Standards and Ambient Air Concentrations Near Cape Canaveral AFS, Florida

Pollutant	2000		2001		2002		Florida Standards	Federal Standards[1]	
	Cocoa Beach	Titusville	Cocoa Beach	Titusville	Cocoa Beach	Titusville		Primary[2]	Secondary[3]
Ozone (ppm)									
1-hour highest[4]	0.095		0.099		0.090		0.12	0.12	Same as Primary Standard
1-hour 2nd highest	0.093	*(no data)*	0.082	*(no data)*	0.085	*(no data)*	-	-	-
8-hour highest[5]			0.080		0.075		0.08	0.08	-
8-hour 2nd highest			0.079		0.074		-	-	-
CO (ppm)									
1-hour highest							35	35	Same as Primary Standard
1-hour 2nd highest	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	-	-	-
8-hour highest							9	9	-
8-hour 2nd highest							-	-	-
NO_2 (ppm)									
1-hour highest	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	-	-	-
1-hour 2nd highest							-	-	-
Annual Arithmetic Mean							0.053	0.053	Same as Primary Standard
SO_2 (ppm)									
1-hour highest							-	-	-
1-hour 2nd highest							-	-	-
3-hour highest	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	0.5	-	0.50
3-hour 2nd highest							-	-	-
24-hour highest							0.10	0.14	-
24-hour 2nd highest							-	-	-
Annual Arithmetic Mean							0.02	0.03	-

Table 3-11. Air Quality Standards and Ambient Air Concentrations Near Cape Canaveral AFS, Florida

Pollutant	**2000**		**2001**		**2002**		**Florida Standards**	**Federal Standards[1]**	
	Cocoa Beach	**Titusville**	**Cocoa Beach**	**Titusville**	**Cocoa Beach**	**Titusville**		**Primary[2]**	**Secondary[3]**
PM_{10} (µg/m^3)									
24-hour highest	*(no data)*	35	*(no data)*	96	*(no data)*	67	150	150	Same as Primary Standard
24-hour 2nd highest		34		56		39	-	-	-
Annual Arithmetic Mean		17		19		18	50	50	-
$PM_{2.5}$ (µg/m^3)									
24-hour highest	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	*(no data)*	65	65	Same as Primary Standard
24-hour 2nd highest							-	-	-
Annual Arithmetic Mean							15	15	Same as Primary Standard

Notes:

[1] National averages (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with a maximum hourly average concentration above the standard, is equal to or less than one.

[2] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[3] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects from a pollutant.

[4] Not to be exceeded on more than an average of one day per year over a three-year period.

[5] Not to be exceeded by the three-year average of the annual 4th highest daily maximum 8-hour average.

Source: Florida DEP, 2003

Table 3-12. Total Area and Point Source Emissions for Brevard County, Florida (Criteria Air Pollutants in Tons Per Year for 1999)					
CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
174,912	33,208	13,738	5,019	25,452	29,383

Source: USEPA, 2004b

Table 3-13. Facility (Point Source) Emissions for Cape Canaveral AFS, Florida (Criteria Air Pollutants in Tons Per Year for 1999)					
CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
2	8	2	2	3	3

Source: USEPA, 2004c

Just as at Vandenberg AFB, the USAF Hearing Conservation Program procedures (described in AFOSH Standard 161-20 and AFI 48-20 Interim Guidance) are used at Cape Canaveral AFS.

Most of the area surrounding Cape Canaveral AFS is open water, with the Atlantic Ocean to the east and the Banana River to the west. The KSC is immediately north, while the City of Port Canaveral is to the south where the closest residential areas exist. Expected sound levels in these areas are normally low (45 to 55 dBA), with higher levels occurring in industrial areas and along transportation corridors (about 60 to 80 dBA).

Infrequent aircraft flyovers, and rocket launches from Cape Canaveral AFS and KSC, increase noise levels for short periods of time. Prior rocket launches from LC-46 have included Athena-1, Athena-2, and the Navy's Trident D-5. LC-20 has been used for small vehicle sub-orbital launches (e.g., Super Loki sounding rockets). The launch of larger space lift vehicles (primarily Atlas and Delta systems) from the Cape can generate intense noise levels of low frequencies. Recorded noise levels for a Delta II launch have been measured at 115 dBA just over half a mile away. The highest recorded noise levels in the area are produced by the space shuttle, which can exceed 160 dBA in the launch area at KSC. (USAF, 1998)

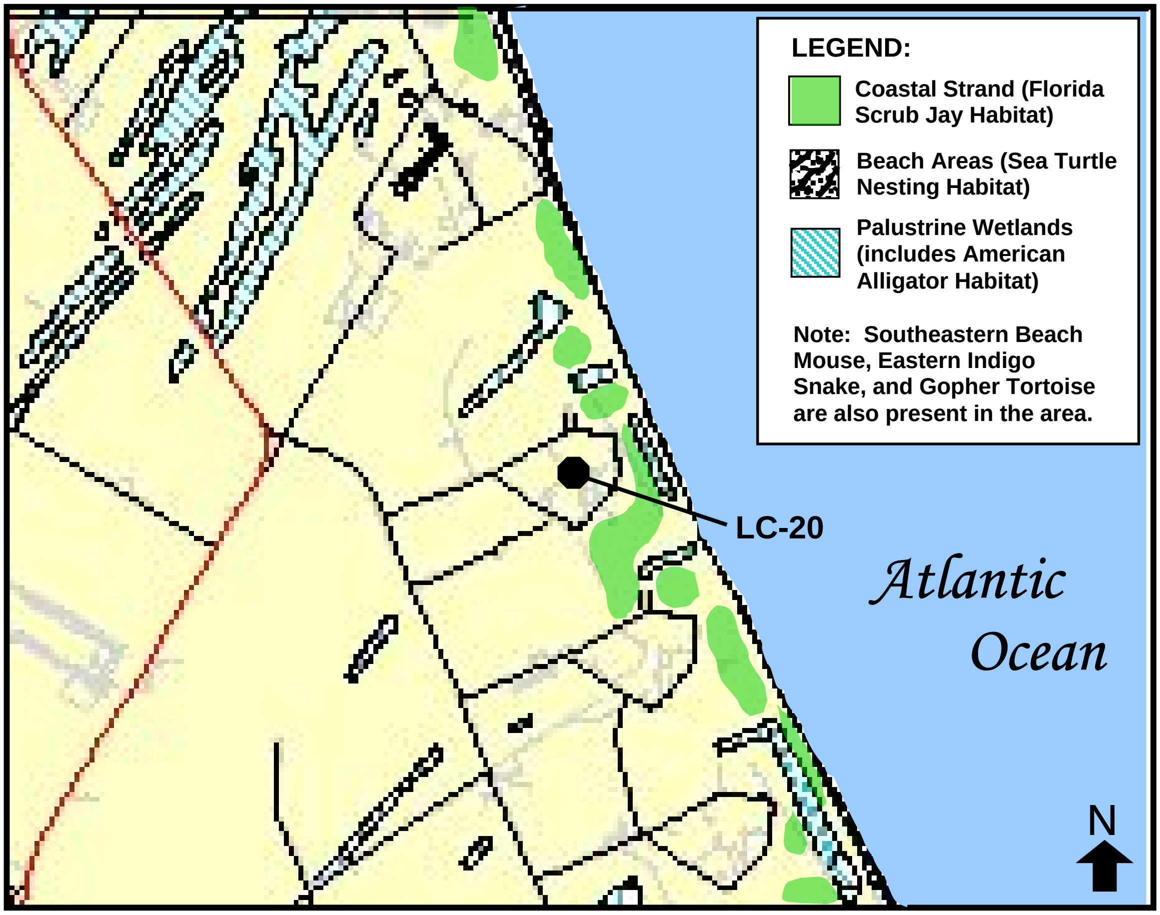
Although rocket launches from Cape Canaveral AFS often produce sonic booms during the vehicle's ascent, the resulting overpressures are directed out over the ocean in the direction of the launch azimuth and generally do not affect the Florida coastline.

3.3.3 BIOLOGICAL RESOURCES

For purposes of analyzing biological resources at Cape Canaveral AFS, the ROI includes those areas in proximity to LC-20 and LC-46, including near-shore waters (see Figures 3-4 and 3-5, respectively). Biological resources within deeper waters and the BOA are described in Section 3.5.2.

3.3.3.1 Vegetation

Several plant communities characterize the LC-20 and LC-46 areas, including coastal dune, coastal strand, freshwater marsh and swamp, and developed/maintained areas dominated by terrestrial grasses and weeds. Dominant vegetation within the coastal dunes includes sea oats and other grasses; small



Source: NASA, 2001b; USAF, 2001d; USFWS, 2002

Figure 3-4. Protected Species and Sensitive Habitat at Cape Canaveral AFS (Launch Complex-20), Florida

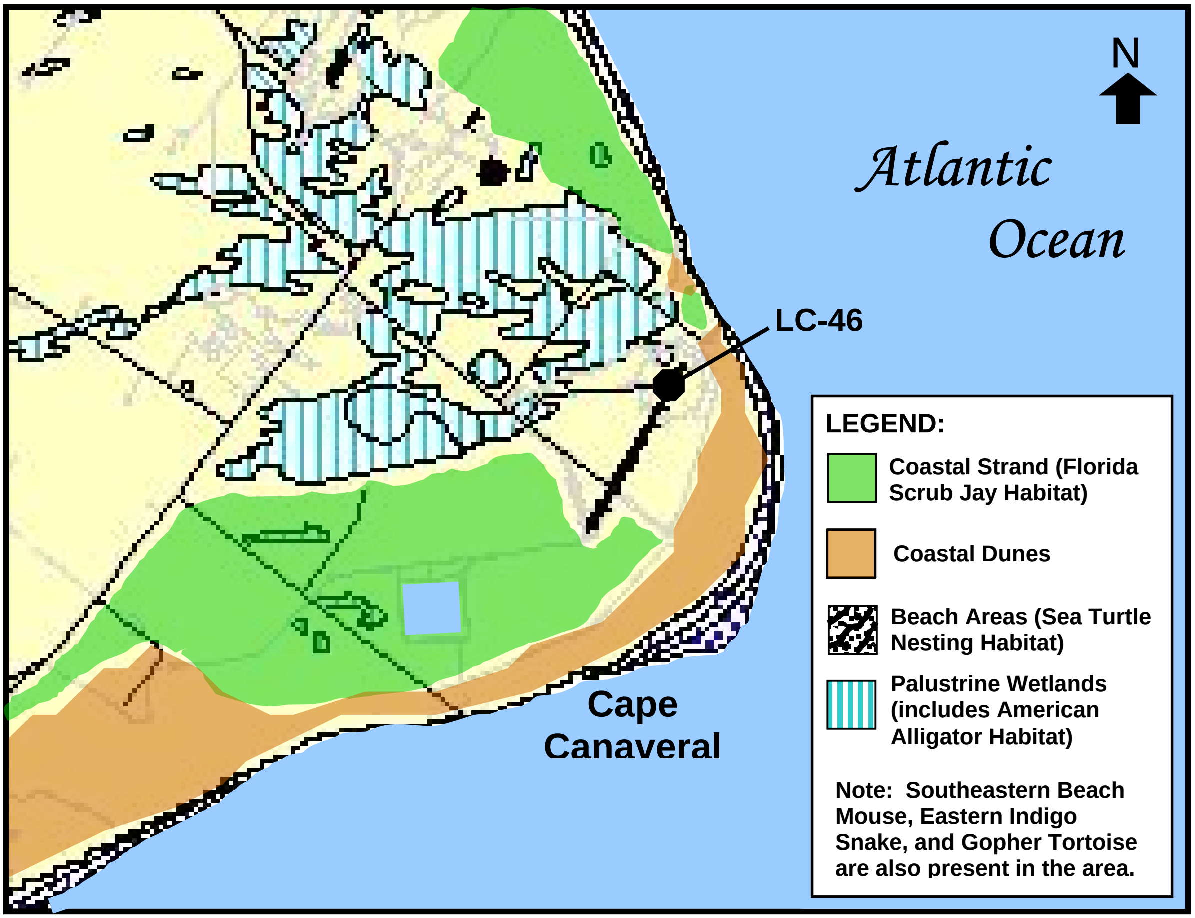
shrubs, such as beach berry, marsh elder, and silver-leaf croton; and some herbs. Occurring more inland, the coastal strand is characterized by a dense shrub layer dominated by saw palmetto. Other shrub vegetation includes sea grape, wax myrtle, snowberry, and nakedwood. (CCAFS/Authority, 1994; NASA, 2001b; NASA/45 SW/Authority, 2002)

The LC-46 includes approximately 70 acres (28 hectares) of semi-improved grounds within the perimeter fence. Consisting of grasses and herbs that are regularly mowed, these grounds provide a 475 to 2,000 ft (145 to 610 m) buffer between the launch pad and the native habitats surrounding LC-46. All of the plant communities in this area have been disturbed to some extent. (CCAFS/Authority, 1994)

The grounds of LC-20 present a slightly smaller but similar setting. Compared to LC-46, LC-20 has very little coastal dune near the site, and much fewer wetlands in the surrounding area. (NASA, 2001b; NASA/45 SW/Authority, 2002)

3.3.3.2 Wildlife

Cape Canaveral AFS is home to numerous migratory seabird species, including sandpipers, gulls, and terns. Both black skimmers and Wilson’s plover have been observed nesting on the beach adjacent to



Source: CCAFS/Authority, 1994; Chambers, 2004; USAF, 2001d; USFWS, 2002

Figure 3-5. Protected Species and Sensitive Habitat at Cape Canaveral AFS (Launch Complex-46), Florida

LC-46 and are known to nest along other portions of the station beaches. If any action on the station were to result in the take of a migratory bird, the appropriate agency is first consulted. Any removal/relocation of eggs or nests must be accomplished in accordance with Federal Depredation Permit MB841530-0. Other birds commonly occurring in the coastal dune and/or coastal strand habitat areas include red-winged blackbirds, mockingbirds, Florida bobwhite, and sparrow hawks. (CCAFS/Authority, 1994; Chambers, 2004; USAF, 2001d)

More than 30 species of mammals inhabit the lands and waters at the Cape, including armadillo, white-tailed deer, bobcat, raccoon, and the cotton rat (CCAFS/Authority, 1994; NASA, 2001b).

Several reptile species also occur in the area, including the Eastern diamondback rattlesnake, Florida pine snake, and several protected sea turtle species. A state species of concern, the gopher tortoise is found in moderate densities on Cape Canaveral AFS, including the areas in and around LC-20 and LC-46. The gopher tortoise prefers open habitats that have herbaceous plants for forage, including disturbed areas such as recent burn areas, road shoulders, fence lines, and launch complexes. Gopher tortoise burrows and other subterranean cavities are commonly used as dens and for egg laying. Up to 20 active burrows have been observed in the coastal strand and dune east of LC-46. Gopher tortoises have been shown to be tolerant of human activities on the station. When a proposed activity is likely to disturb gopher tortoise burrows, station biologists will relocate impacted tortoises to other suitable areas. All tortoise relocations must be completed in accordance with Gopher Tortoise Relocation Permit WR04151. This permit allows the relocation of up to 150 tortoises from May 2004 through December 2007. The USAF is required to submit a report for each relocation project. (CCAFS/Authority, 1994; Chambers, 2004; EDCFSC/PAFB, 2005; NASA, 2001b; USAF, 2001d)

3.3.3.3 Threatened and Endangered Species

3.3.3.3.1 Listed Floral Species

No Federally threatened or endangered plant species are found on Cape Canaveral AFS. Though several state-listed plants occur on the station, none have been identified in proximity to LC-20 and LC-46. (CCAFS/Authority, 1994; NASA, 2001; NASA/45 SW/Authority, 2002; USAF, 2001d)

3.3.3.3.2 Listed Faunal Species

There are several listed wildlife species occurring within the ROI at Cape Canaveral AFS. These and other protected species are identified in Table 3-14.

Table 3-14. Threatened, Endangered, and Other Protected Species Occurring at Cape Canaveral AFS (Launch Complex-20 and -46), Florida

Common Name	Scientific Name	Federal Status	Florida Status
Birds			
Florida scrub jay	*Aphelocoma coerulescens*	T	T
Black skimmer	*Rynchops niger*	MB	SC
Least tern	*Sterna antillarum*	MB	T
Piping plover	*Charadrius melodus*	T	T
Reptiles			
American alligator	*Alligator mississippienisis*	T(S/A)	SC
Eastern indigo snake	*Drymarchon corais couperi*	T	T
Gopher tortoise	*Gopherus polyphemus*	-	SC
Leatherback sea turtle	*Dermochelys coriacea*	E	E
Green sea turtle	*Chelonia mydas*	E	E
Loggerhead sea turtle	*Caretta caretta*	T	T
Hawksbill sea turtle	*Eretmochelys imbricata*	E	E
Kemp's ridley sea turtle	*Lepidochelys kempi*	E	E
Mammals (includes near-shore waters)			
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	T	T
Florida Manatee	*Trichechus manatus*	E	E

Notes:
E = Endangered
T = Threatened
T(S/A) = Similarity of Appearance to a Threatened Taxon in the Entire Range
MB = Protected under the Migratory Bird Treaty Act
SC = Species of Concern

Source: Bauer, 2005; Chambers, 2004; FFWCC, 2004; NASA, 2002a; Rowland, 2003; USAF, 1998; USFWS, 2000b

In the vicinity of LC-20 and LC-46, the Federally threatened Florida scrub jay occupies coastal strand vegetation adjacent to the sites. In addition, the birds are sometimes seen along nearby grassed road shoulders and in other mowed areas within and outside the launch complexes. A survey conducted in 2003 identified three groups of scrub jays residing/nesting in the area surrounding LC-46 (Bauer, 2005; Chambers, 2004).

A colony of least terns nest on station beaches, including beach areas adjacent to LC-46. Nests generally occur within the transition zone between beach dune and coastal grassland, if the vegetation is sparse. Nesting typically occurs between April and August. (Chambers, 2004; USAF, 2001d)

Though rare in this area, piping plovers may occur on Station beaches during the non-breeding season; July through March (EDCFSC/PAFB, 2005).

The American alligator is Federally listed as threatened because of its similarity in appearance to another endangered species, the American crocodile (*Crocodylus acutus*), which is not found in Brevard County. The American alligator has made a strong recovery in Florida. Alligators inhabit and reproduce in all Cape Canaveral AFS waters. The population is on an upward trend as indicated by numerous sightings each summer of juvenile alligators throughout the station's drainage canal system. Several alligators have been observed in the drainage canals located north and west of LC-46. Though the wetland areas near LC-20 are less extensive, alligators are still expected to occur in these areas, but to a lesser degree. (CCAFS/Authority, 1994; USAF, 2001d)

Federally and state listed as a threatened species, the Eastern indigo snake has been identified throughout Cape Canaveral AFS. This species is known to occur in the area around LC-20 and may occur around LC-46. These snakes are strongly associated with high, dry, well-drained sandy soils, closely paralleling the dune habitat preferred by gopher tortoises. Though not documented on the station, the snakes have been found to co-inhabit gopher tortoise burrows. The only time indigo snakes may be relocated is during relocation of gopher tortoises. In accordance with the Gopher Tortoise Relocation Permit described earlier, no more than one indigo snake encountered may be relocated. Should additional specimens of this species be encountered, the capture operation is suspended and the Florida Fish and Wildlife Conservation Commission is contacted for instructions. (NASA, 2001; USAF, 2001d)

Of the five sea turtles observed in the waters offshore at Cape Canaveral AFS (Table 3-14), all but the Hawksbill and Kemp's ridley sea turtles are known to nest on station beaches, including those beach areas adjacent to LC-20 and LC-46. Each year, between May and August, over 3,000 loggerhead turtle nests are deposited on the station beaches. The 1998 nesting season was a record year for green turtle nesting activity, with over 100 nests recorded. During the recent 2005 nesting season, a record number of eight leatherback nests were recorded by station biologists. (Bauer, 2005; Chambers, 2004, 2005; NASA, 2001; USAF, 2001d; USFWS, 2000b)

The southeastern beach mouse is found along the entire reach of coastline on Cape Canaveral AFS, mostly within areas of coastal dune and coastal strand vegetation. Prior trapping studies have confirmed the presence of beach mice in areas adjacent to LC-46, as well as the maintained area within the perimeter fence. The species is not known to inhabit the area within the LC-20 complex boundary, but has been identified in the areas immediately east of the complex. If a project will potentially impact beach mice, the animals may be live trapped and relocated out of the project area, and/or the USFWS may issue a take permit for the project. It is the decision of the USFWS to determine what mitigation measures, in any, to take. (Bauer, 2005; CCAFS/Authority, 1994; USAF, 2001d; USFWS, 2002)

Though not occurring in close proximity to the LC-20 and LC-46 launch sites, the endangered Florida manatee can be found in the Banana River along the western boundary of Cape Canaveral AFS (USAF, 2001d).

3.3.3.4 Environmentally Sensitive and Critical Habitats

There is no designated critical habitat under Section 4 of the Endangered Species Act located on Cape Canaveral AFS. However, the station does contain many wetlands and associated vegetation communities. The USFWS National Wetlands Inventory conducted in 1994 identified a total of 2,235 acres (905 hectares) of wetlands on Cape Canaveral AFS. Several large palustrine, emergent wetland areas are located approximately 750 ft (229 m) from the LC-46 launch pad. At LC-20, there are some small palustrine wetland areas just outside the LC-20 boundaries. (NASA, 2001; USAF, 2001d, 1998)

The USFWS has determined that Cape Canaveral AFS is a core Florida scrub jay area and is highly valuable to the recovery of the species. Because of the importance of this habitat, significant loss resulting from construction at the station is compensated at a 4:1 ratio (four acres of scrub restored for every acre destroyed). The Scrub-jay Management Plan for CCAFS includes status and distribution studies, as well as management techniques for this species. A Scrub-jay Monitoring Program is also in place to study demographic characteristics of the birds occurring on the station. (USAF, 2001d)

At Cape Canaveral AFS, the beach areas from mean low tide to just behind the leading dune are considered protected nesting habitat for Federally listed sea turtles (USAF, 1998). In 1984, the USAF initiated a Sea Turtle Preservation Program for the conservation of nesting sea turtles at the station (NASA/45 SW/Authority, 2002). This program involves the protection, conservation, and management of threatened and endangered sea turtles, and their nests, at Cape Canaveral AFS. Biologists conduct daily nesting surveys from May through September to count and record nesting activities. Biologists also conduct turtle stranding and salvage operations, as well as nest relocation activities. All sea turtle work on Cape Canaveral AFS is permitted under the Florida Fish and Wildlife Conservation Commission Sea Turtle Permit No. 075. All personnel listed on the permit are properly trained (USAF, 2001d). Also, as part of the Preservation Program, and in accordance with 45th SWI 32-7001 (*Exterior Lighting Management*), the station has implemented Light Management Plans to minimize light impacts on sea turtles nesting on the beaches at night. Under the SWI requirements, organizations, tenants, and residents are responsible for minimizing exterior lighting from April 1 through October 31, between 9:00 pm and 6:00 am. Exterior lighting that is not mission-, safety-, or security-essential must be extinguished during this time frame.

The Merritt Island National Wildlife Refuge encompasses the Banana River up to the western border of Cape Canaveral AFS, all of the Kennedy Space Center, and areas further north. The refuge manages habitat for over 500 species of wildlife, including 21 Federal and state listed threatened and endangered species, and has one of the most important sea turtle nesting beaches in the United States. (USFWS, 2000a)

Located within the boundaries of the Merritt Island National Wildlife Refuge, the Banana River is also designated by the USFWS as critical habitat for the Florida manatee. Because of the increasing number of manatees in this area, public powerboats are denied access to most of the river waters adjacent to Cape Canaveral AFS. (USAF, 2001d)

For purposes of conserving and managing fish stocks in the Atlantic Ocean, the South Atlantic Fishery Management Council has authority over the fisheries from 3 to 200 mi (5 to 322 km) offshore of the State of Florida. Through consultations, the USAF has agreed to implement the NOAA Fisheries Service conservation recommendations to minimize adverse impacts to EFH offshore from launch anomalies (USAF, 2000b).

3.3.4 HEALTH AND SAFETY

At Cape Canaveral AFS, the ROI for health and safety is limited to the US transportation network used in shipping rocket motors to the station, existing station facilities supporting the OSP, off-station areas within launch hazard zones, and areas downrange along the launch vehicle's flight path. The health and safety ROI includes station personnel, contractors, and the general public.

Just as at Vandenberg AFB (Section 3.1.5), program managers at Cape Canaveral AFS use DOD requirements, the AFPD-91 series, AFI-91 series, AFOSH standards, and applicable Federal and state regulations to implement the safety program. The 45th SW Safety Office is responsible for establishing, complying with, and implementing the Range Safety Program at the station in accordance with AFSPCMAN 91-710, and the *45th SW/Patrick AFB Launch Site Safety Assessment* for operation of the Cape Canaveral Spaceport.

The 45th SW has in place specific procedures to address ground safety requirements for the handling, transportation, and storage of rocket propellants and related ordnance. Range safety procedures provide for flight safety, range clearance and surveillance, sea-surface area clearance and surveillance, and commercial air traffic control. They include published NOTMARs and NOTAMs in coordination with the FAA and the US Coast Guard. Criteria used in determining launch debris hazard risks are in accordance with RCC 321-02 (RCC, 2002). Atmospheric dispersion models are also run to predict toxic hazard corridors (THCs) for both nominal and aborted launches, as well as spills or releases of toxic materials in storage or that occur during loading/unloading of tanks. The Safety Office uses the THCs to reduce the risk of exposure of station personnel and the general public to toxic materials and gases.

As mentioned earlier for Vandenberg AFB, use of radiological materials in launch vehicle payloads must comply with AFI 91-110. In such cases, a nuclear safety review and approval is required prior to launch.

For the transportation of rocket components to Cape Canaveral AFS, major road or rail routes would be used for ground transportation requirements. The health and safety of travel on US transportation corridors is under the jurisdiction of each State's Highway Patrol and DOT, and the US DOT. The USAF coordinates with each state DOT whenever the transport of hazardous missile/launch vehicle components is planned to occur.

3.3.5 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

For the analysis of hazardous materials and waste management at Cape Canaveral AFS, the ROI is defined as those station facilities that: (1) handle and transport hazardous materials; (2) collect, store (on a short-term basis), and ship hazardous waste; and (3) are in close proximity to existing IRP sites.

At Cape Canaveral AFS, hazardous materials utilized by Air Force organizations are managed in a similar manner as at Vandenberg AFB using a HazMart Pharmacy. Tenants and contractors operating at the station are required to develop and implement their own hazardous materials management plans, which include the option of enrolling in the base's HazMart. The Joint Propellants Contractor on station controls the purchase, transport, and temporary storage of hazardous propellants. (CCAFS, undated; Chambers, 2004; NASA, 2002a; USAF, 2000a)

Hazardous waste management is regulated under RCRA and the Florida Administrative Code (FAC) 62-730. These regulations are implemented by 45th SW Operations Plan 19-14, which addresses the proper identification, management, and disposition of hazardous waste generated at the station. The transportation of most hazardous wastes on station is assigned to the Joint Base Operations Support Contractor. This particular contractor directs and documents relevant actions for hazardous or controlled waste handling, sampling, storage, transportation, treatment, and disposal/recovery for compliance with all local, state, and Federal regulations. (Chambers, 2004; NASA, 2002a)

Response to hazardous spills is covered under the Consolidated Comprehensive Emergency Management Plan (CCEMP), document JHB-2000 revision A. The CCEMP establishes uniform policy guidelines for the effective mitigation of, preparation for, response to, and recovery from a variety of emergency situations. The CCEMP is applicable to all USAF and contractor organizations, and to all other Government agencies located on station. (NASA, 2002a)

The 45th SW Pollution Prevention Program Guide and Pollution Prevention Management Action Plan establish the overall strategy, responsibilities, and specific objectives for reducing pollution in the environment (NASA, 2002a).

Again, the transportation of hazardous materials and waste outside the station boundaries is governed by the US DOT regulations within 49 CFR 100-199.

In regards to IRP-related issues at proposed launch facilities, site assessments of LC-20 conducted in the early 1990's determined surface soil contamination at certain locations around the site. The primary chemical of concern is Aroclor 1260, a type of PCB. Paint coatings that were sandblasted off the site support structures are suspected to have contained the PCBs. Deluge basin discharge and dispersion of the paint chips are considered to be the main cause of site contamination. In the mid-to-late 1990's, approximately 1,109 tons of contaminated soils and sediments were removed from the site. Though soils at the site have been remediated to industrial standards with no risk to workers, land use restrictions prevent uses other than for industrial applications. As specified in the Land Use Control Implementation Plan (LUCIP) prepared for LC-20, soils are not to be disturbed or moved during property development, maintenance, or construction without USAF approval, application of proper engineering controls, and use of personal protection equipment by site workers. (CCAFS, 2001a; NASA, 2001b)

At LC-46, the principal area of concern is a former fire training area, which was located just southeast of the current launch pad. Prior to 1966, contaminated fuels and waste oils were burned at this site during training sessions. These materials likely contained metals, and halogenated and nonhalogenated solvents. When the current LC-46 was built in 1985, the area was re-graded, and new roads and structures constructed. Since then, remedial investigations of the site have identified low-level concentrations of antimony, arsenic, benzene, and vinyl chloride in the groundwater. Arsenic can also be found in the soil, but at concentrations not exceeding background levels in soils found elsewhere on CCAFS. A long-term monitoring program for groundwater in the surficial aquifer was implemented in 1997 and is ongoing. In addition, a LUCIP was initiated to prohibit groundwater withdrawals at the site. (CCAFS, 2001b)

3.4 WALLOPS FLIGHT FACILITY

Wallops Flight Facility encompasses approximately 6,500 acres (2,630 hectares) over three different land parcels. The Wallops Island Launch Site parcel is a barrier island on Virginia's Eastern Shore, about 40 mi (64 km) south of Salisbury, Maryland, and just a few miles southwest of Chincoteague, Virginia. The NASA/Goddard Space Flight Center operates Wallops Flight Facility in support of space and earth science research, and aerospace technology development, through the use of rockets, balloons, aircraft, and Shuttle-based carriers.

3.4.1 AIR QUALITY

In Virginia, air quality is assessed on both a county and regional basis. Air quality at Wallops Flight Facility is regulated under the Virginia Administrative Code (VAC) (9 VAC 5-30), and Region 3 of the USEPA. The Virginia Ambient Air Quality Standards are not significantly different from the NAAQS shown in Table 3-1. For analysis purposes, the ROI is Accomack County and the immediate area offshore.

Accomack County meets all of the Federal and state standards for the criteria pollutants (USEPA, 2004a). No ambient air quality data is available for the vicinity of Wallops Flight Facility; the closest monitoring station is 50 mi (80 km) southwest (Gluth, 2003; Sorensen, 2003).

Annual emission estimates for individual sources are based on their normal operating schedule, and take into account the effects of installed pollution control equipment and of regulatory restrictions on operating conditions (USEPA, 2004b). Table 3-15 provides information on criteria air pollutant emissions for Accomack County in 1999, the latest date for which comprehensive air data is available from the USEPA.

Table 3-15. Total Area and Point Source Emissions for Accomack County, Virginia (Criteria Air Pollutants in Tons Per Year for 1999)

CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
23,549	2,147	3,097	1,042	964	6,567

Source: USEPA, 2004b

Table 3-16 provides information on criteria air pollutant facility (point source) emissions for Wallops Flight Facility in 2001, the latest date for which comprehensive air data is available from the Virginia Department of Environmental Quality (DEQ). Though no data is available on area source emissions (e.g., launch vehicle fueling operations), the values shown for the facility are a small fraction of the county emissions.

Table 3-16. Facility (Point Source) Emissions for Wallops Flight Facility, Virginia (Criteria Air Pollutants in Tons Per Year for 2001)

CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
2	14	1	*(no data)*	18	1

Source: Virginia DEQ, 2004

Stationary sources of air emissions include operation of a central boiler plant and numerous individual boilers, support activities (paint booths, fume hoods, construction, etc.), and a rocket motor open-burn/ open-detonation area located at the southern end of Wallops Island. Mobile sources include aircraft flight operations; support equipment; rocket launches; and Government, commercial, and personal motor vehicles. (NASA, 2003a).

Providing dispersion of emissions, the average prevailing wind speed at Wallops Flight Facility is 20 mph (32 kph) and is from the south. The greatest mean wind speeds occur during February and March, while the lowest speeds occur in July and August. (NASA, 1999, 2001a)

3.4.2 NOISE

As described in Section 3.1.2, the ROI for noise analysis is defined as the area or areas within the 85-dB ASEL contours generated by proposed OSP launches. This equates to an area within a few miles of the launch sites.

Wallops Island is surrounded by water, with marshlands along the entire western border and the Atlantic Ocean to the east. The launch sites on the island are located approximately 2.5 mi (4 km) from the mainland. Noise-sensitive receptors within the area include several small towns (such as Atlantic, Assawoman, and Temperanceville), and other rural homes and farms. The Wallops Island National Wildlife Refuge and Assateague Island National Seashore also lie a few miles to the northeast.

Noise exposure limits for workers at Wallops Flight Facility are in accordance with OSHA requirements under 29 CFR 1910.95. Outside the facility, the most common man-made noise is from vehicular traffic and aircraft activities. Existing noise levels can be expected to range from 30 dBA in quiet rural areas, up to 64 dBA during peak traffic periods along the major roads (NASA, 1997). Other less frequent, but more intense, sources of noise in the ROI are the rocket launches from the Wallops Island Launch Site. Scout, Black Brant, Terrier, and numerous other sounding rockets have been launched from the island. The Conestoga is the largest rocket launched from Wallops Island to date. For its launch, an overall sound pressure level of approximately 107 dB was expected at 7.5 miles (12 km) from the launch site (NASA, 1997). Equivalent A-weighted sound levels would be substantially lower.

Although rocket launches from Wallops Flight Facility can produce sonic booms during the vehicle's ascent, the resulting overpressures are directed out over the ocean in the direction of the launch azimuth. In conducting launches, NASA only permits sonic booms to occur over ocean waters, so as not to impact populated areas along coastal areas (NASA, 2005).

3.4.3 BIOLOGICAL RESOURCES

For purposes of analyzing biological resources at Wallops Flight Facility, the ROI includes all of the Wallops Island Launch Site property, neighboring islands, and near-shore waters and marshes (see Figure 3-6). Biological resources within deeper waters and the BOA are described in Section 3.5.2.

3.4.3.1 Vegetation

Wallops Island is a barrier island that contains various stages of ecological succession, including beaches, dunes, swales, marsh, and some maritime forests (NASA, 1999).

On the eastern side of the island, an extensive seawall, built where the upper beach zone would normally exist, protects facilities within the ROI from beach erosion. The upper beach zone extends from the high-tide mark to the crest of the eastern-most dunes. Dominant species within the dune system include seabeach orach, common saltwort, sea rocket, American Beachgrass, and seaside goldenrod. The central portion of the island is dominated by common reed grass, an invasive species. Other species found on Wallops Island include northern bayberry, wax myrtle, groundsel-tree, and loblolly pine. (NASA, 1999)

Areas off the western side of the island are mostly tidal marsh wetlands with intertwining guts (small streams). The low marsh, which is flooded at high tide, is dominated by saltmarsh cordgrass. Salt meadow cordgrass predominates in the high marsh areas, which are flooded by approximately 50 percent of the high tides. (NASA, 1997; 1999)

Source: NASA, 1999

Figure 3-6. Protected Species and Sensitive Habitat at Wallops Flight Facility (Wallops Island), Virginia

Vegetation around facilities and launch pads are maintained by mowing and clearing, and through the use of herbicides (NASA, 1999). This provides a buffer between the facilities and the native habitats.

3.4.3.2 Wildlife

The wide range of terrestrial and aquatic environments found at Wallops Island provide habitat for numerous wildlife species. Because of its coastal location along the Atlantic Flyway route, Wallops Island is an important stop for migratory ducks, geese, shorebirds, songbirds, and raptors. Bird species commonly seen here include laughing gulls, red-winged blackbirds, sanderlings, willets, least tern, Forster's tern, and song sparrows. (NASA, 1999, 2003b, 2005)

Some of the amphibian and reptile species found on the island, and in the local estuaries and tidal flats, include Fowler's toad, black rat snake, hognose snake, northern fence lizard, snapping turtle, and the diamondback terrapin. Mammalian species such as the raccoon, red fox, white-footed mouse, meadow vole, opossum, cottontail rabbit, and white-tailed deer also thrive here. (NASA, 1999, 2003b, 2005)

3.4.3.3 Threatened and Endangered Species

3.4.3.3.1 Listed Floral Species

No Federal or state threatened or endangered floral species have been identified on Wallops Island (NASA, 1997, 1999).

3.4.3.3.1 Listed Faunal Species

Several listed bird species are known to occur at various locations on Wallops Island and are identified in Table 3-17.

Table 3-17. Threatened, Endangered, and Other Protected Species Occurring at Wallops Flight Facility (Wallops Island), Virginia

Common Name	Scientific Name	Federal Status	Virginia Status
Birds			
Bald eagle	*Haliaeetus leucocephalus*	T, PD	T
Piping plover	*Charadrius melodus*	T	T
Wilson's plover	*Charadrius wilsonia*	-	E
Gull-billed tern	*Sterna nilotica*	-	T
Upland sandpiper	*Bartramia longicauda*	-	T
Peregrine falcon	*Falco peregrinus*	-	T

Notes:
E = Endangered
T = Threatened
PD = Proposed for Delisting

Source: NASA, 1999; USFWS, 2005; VDGIF, 2002

During the migratory season, upland sandpipers may occur in large grassy areas of Wallops Island. Piping plover nesting habitat has been delineated on the dunes at the northern and southern ends of the island, as shown on Figure 3-6. Wilson's plovers tend to nest with piping plovers. Gulled-billed terns can be found nesting on the beaches or mud flats of Wallops Island. There is a resident pair of peregrine falcons that nest on a hacking tower located on the northwest side of Wallops Island. In addition, peregrine falcons occur along the Wallops Island beach during their fall migration. Bald eagles have also been seen passing through the area. Though an active bald eagle nest exists just north of the Wallops Flight Facility Main Base, no eagle nests have been identified on Wallops Island. (NASA, 1999, 2003b, 2005)

3.4.3.4 Environmentally Sensitive and Critical Habitats

On Wallops Island, piping plover nesting areas exist on both the northern and the southern ends of the island (Figure 3-6). Designated as critical habitat by the USFWS, both areas are closed to vehicle and human traffic during the nesting season, from mid-March through mid-September. Biologists from the nearby Chincoteague National Wildlife Refuge and the Virginia Department of Game and Inland Fisheries monitor plover nesting activities and provide advice on protection and management of the plover population. Other species, in addition to the piping plover, have benefited from the protected habitat. For example, Wilson's plover is known to also breed in these same areas. (NASA, 1999, 2005)

Wallops Island is located southeast of the Chincoteague National Wildlife Refuge and the Assateague Island National Seashore, separated by the Chincoteague Inlet. Located on Assateague Island, the refuge and national seashore act as safe havens for various wildlife species. In particular, both migratory and non-migratory bird species benefit from these protected areas (NASA, 1999). Assateague Island is also home of the nationally recognized Chincoteague ponies, a feral breed of small horses. To lessen the impact on the local ecology, approximately 150 adult ponies are allowed to reside on the Virginia side of the island (NPS, 2005).

The Mid-Atlantic Fisheries Management Council manages the coastal fisheries that include the embayments, estuaries, and ocean waters surrounding Wallops Island. Within these waters, there are about 105 EFH species of fish, invertebrates, and macroalgal. Some of the species found in these waters are red hake, winter flounder, windowpane flounder, Atlantic sea herring, bluefish, summer flounder, squid, Atlantic surf clam, scup, black sea bass, king mackerel, Spanish mackerel, cobia, red drum, sand tiger shark, Atlantic sharpnose shark, dusky shark, and sandbar shark. (NASA, 2003b, 2005)

3.4.4 HEALTH AND SAFETY

At Wallops Flight Facility, the ROI for health and safety is limited to the US transportation network used in shipping rocket motors to the site, existing on-site facilities supporting the OSP, off-base areas within launch hazard zones, and areas downrange along the launch vehicle's flight path. The health and safety ROI includes NASA personnel, contractors, and the general public.

The Wallops Flight Facility Safety Office is responsible for approving project-specific ground and flight safety plans, while management is responsible for approving the Operations and Safety Directive for each activity or mission (NASA, 2003b). The following documentation is in place to provide specific guidance for safety and emergency response:

- Integrated Contingency Plan, May 2001
- Range User's Handbook, Revision 2, 2001
- Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility (RSM-2002), June 28, 2002
- Wallops Safety Manual for Wallops Flight Facility (WSM-2002), August 28, 2002
- Goddard Space Flight Center/Wallops Flight Facility Launch Site Safety Assessment, March 1999
- NASA Department Operating Guideline, Hydrazine Response Plan, 2004
- NASA Safety Manual (NPR 8715.3), March 31, 2004
- NASA Safety Standard for Explosives, Propellants and Pyrotechnics (NASA-STD-8719.12).

Similar to that described previously for Vandenberg AFB (Section 3.1.5), these procedures provide for ground safety, flight safety, range clearance and surveillance, sea-surface area clearance and surveillance, and commercial air traffic control. They include published NOTMARs and NOTAMs, as well as coordination with the US Coast Guard and the FAA. Criteria used in determining launch debris hazard risks are consistent with those employed by other national ranges, such as the Eastern and Western Ranges, and with RCC 321-02 (NASA, 2002b).

In cases where radiological materials are to be carried on launch vehicles or in payloads, the type and quantity of radiological material used must comply with Chapter 5 (*Nuclear Safety for Launching of Radioactive Materials*) of NPR 8715.3. The NASA Nuclear Flight Safety Assurance Manager determines acceptability for the potential risk of launching and use of nuclear materials in space.

The RSO at Wallops Flight Facility provides range safety policy guidance and direction and operational oversight during test range missions. The RSO acts as the approval authority for Ground and Flight Safety Risk Analyses and Safety Plans. The RSO or designee implements the measures specified in Ground and Flight Safety Plans during test range operations. (NASA, 2002b)

Wallops Flight Facility maintains 24-hour fire protection stations on the Main Base and on Wallops Island. Response personnel are trained in hazardous materials emergency response, crash rescue, and fire suppression. Mutual aid agreements have been established between Wallops Flight Facility and the local volunteer fire companies in Atlantic and Chincoteague for any additional assistance. (NASA, 2003b)

For the transportation of rocket components to Wallops Flight Facility, major road or rail routes would be used for ground transportation requirements. The health and safety of travel on US transportation corridors is under the jurisdiction of each State's Highway Patrol and DOT, and the US DOT. The USAF coordinates with each state DOT whenever the transport of hazardous missile/launch vehicle components is planned to occur.

3.4.5 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

For the analysis of hazardous materials and waste management at Wallops Flight Facility, the ROI is defined as those installation areas that handle and transport hazardous materials; and collect, store (on a short-term basis), and ship hazardous waste.

Developed in accordance with the Federal Hazard Communication Program, the Wallops Flight Facility Environmental Office has prepared an Integrated Contingency Plan (ICP) (NASA, 2001a) that combines requirements for the implementation of the following:

- Spill Prevention, Control, and Countermeasures Plan, as required by 40 CFR Part 112 and 9 VAC 25-91-170
- Hazardous Substance Contingency Plan, as required by 40 CFR 262.34 (which references 40 CFR 265, Subpart D) and 9 VAC 20-60-265
- Hazardous Waste Operations and Emergency Response, per 29 CFR 1910.120
- Storm Water Pollution Prevention Plan, as required by 9 VAC 25-31-120 pursuant to the current Virginia Pollutant Discharge Elimination System General Permit #VA0024457

The overall purpose of the ICP is to minimize hazards from the release of oil or hazardous substances through coordination efforts involving facility staff, the local fire and police departments, outside contractors, the Virginia Department of Environmental Quality, and the USEPA.

The Wallops Main Base and the Mainland/Wallops Island areas are both classified as large quantity generators of hazardous waste. Hazardous waste at the accumulation areas can be stored onsite for up to 90 days after the date of initial accumulation. (NASA, 2001a)

The Wallops Flight Facility has established a Pollution Prevention Plan and a coordinator who is responsible for administering this plan. Pollution prevention teams are formed as needed to address specific waste minimization and pollution prevention opportunities. (NASA, 2003b)

Again, the transportation of hazardous materials and waste is governed by the US DOT regulations within 49 CFR 100-199.

There are no IRP-related issues associated with the proposed launch sites at Wallops Flight Facility.

3.5 GLOBAL ENVIRONMENT

3.5.1 UPPER ATMOSPHERE/STRATOSPHERIC OZONE LAYER

For the purpose of this EA, the "upper atmosphere" refers to the stratosphere, which extends from 32,800 ft (10 km) to approximately 164,000 ft (50 km) in altitude (NOAA, 2001).

The stratosphere contains the Earth's ozone layer, which varies as a function of latitude and season. The ozone layer plays a vital role in absorbing harmful ultraviolet radiation from the sun. Over the past 20 years, concentrations of ozone in the stratosphere have been threatened by anthropogenic (human-made) gases released into the atmosphere. Such gases include chlorofluorocarbons (CFCs), which have been widely used in electronics and refrigeration systems, and the lesser-used Halons, which are extremely effective fire extinguishing agents. Once released, the CFCs and Halons are mixed worldwide by the motions of the atmosphere until, after 1 to 2 years, they reach the stratosphere, where they are broken down by ultraviolet radiation. The chlorine and bromine atoms, within the respective CFC and Halon gas molecules, are released and directly attack ozone molecules, depleting them. Through global compliance with the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, and its later Amendments, the worldwide production of CFCs and other ozone-depleting substances has been drastically reduced, and banned in many countries. A continuation of these compliance efforts is expected to allow for a slow recovery of the ozone layer. (NOAA, 2001; WMO, 1998)

3.5.2 BROAD OCEAN AREA/MARINE LIFE

The affected environment of the BOA is described in the following subsections in terms of its physical and chemical properties, biological diversity, threatened and endangered species, and other protected marine mammal species. For purposes of this analysis, the ROI is focused primarily on the launch corridors over the Atlantic and Pacific Oceans, where motor drop zones and other debris impacts might occur (see Section 2.1.5).

3.5.2.1 Physical and Chemical Properties

The general composition of the ocean includes sodium chloride, dissolved gases, minerals, and nutrients. These components determine and direct the interactions between the seawater and its inhabitants. The most important physical and chemical properties are salinity, pH, density, dissolved gases, and temperature. Water quality in the open ocean is excellent, with high water clarity, low concentration of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons (PMRF, 1998).

3.5.2.2 Noise in the Ocean Environment

In the marine environment, there are many different sources of noise, both natural and anthropogenic. Biologically produced sounds include whale songs, dolphin clicks, and fish vocalizations. Natural geophysical sources include wind-generated waves, earthquakes, precipitation, and lightning storms. Anthropogenic sounds are generated by a variety of activities, including commercial shipping, geophysical surveys, oil drilling and production, dredging and construction, sonar systems, DOD test activities and training maneuvers, and oceanographic research. Intentional sounds are produced for an explicit purpose, such as seismic surveying to find new fossil fuel reservoirs. Unintentional sounds are generated as a byproduct of some other activity, such as noise radiated by a ship's machinery as it crosses the ocean. (NRC, 2003; URI OMP, 2003)

While measurements for sound pressure levels in air are referenced to 20 micro Pascals (µPa), underwater sound levels are normalized to 1 µPa at 3.3 ft (1 m) away from the source, a standard used in underwater sound measurement. Within the ROI, some of the loudest underwater sounds generated are most likely to originate from storms, ships, and some marine mammals. The sound of thunder from lightning strikes can have source levels of up to 260 dB (referenced to 1 µPa). A passing supertanker can generate up to 190 dB (referenced to 1 µPa) of low frequency sound. For marine mammals, dolphins are known to produce brief echolocation signals over 225 dB (referenced to 1 µPa), while mature sperm whale clicks have been calculated as high as 232 dB (referenced to 1 µPa). (Boyd, 1996; Nachtigall, et al., 2003; NRC, 2003; Richardson, et al., 1995; URI OMP, 2003)

3.5.2.3 Biological Diversity

Although oceans have far fewer species of plants and animals than terrestrial and freshwater environments, an incredible variety of living things reside in the ocean. Marine life ranges from microscopic one-celled organisms to the world's largest animal, the blue whale. Marine plants and plant-like organisms can live only in the sunlit surface waters of the ocean, the photic zone, which extends to only about 330 ft (101 m) below the surface. Beyond the photic zone, the light is insufficient to support plants and plant-like organisms. Animals, however, live throughout the ocean from the surface to the greatest depths.

The average depth of the ocean area within much of the ROI is over 12,000 ft (3,660 m). Within the ROI, marine biological communities can be divided into two broad categories: pelagic and benthic. Pelagic communities live in the water column and have little or no association with the bottom, while benthic communities live within or upon, or are otherwise associated with, the bottom.

The organisms living in pelagic communities may be drifters (plankton) or swimmers (nekton). The plankton includes larvae of benthic species, so a pelagic species in one ecosystem may be a benthic species in another. The plankton consists of plant-like organisms (phytoplankton) and animals (zooplankton) that drift with the ocean currents, with little ability to move through the water on their own. The nekton consists of animals that can swim freely in the ocean, such as fish, squids, sea turtles, and marine mammals. Benthic communities are made up of marine organisms that live on or near the sea floor, such as bottom dwelling fish, shrimps, worms, snails, and starfish.

3.5.2.4 Threatened, Endangered, and Other Protected Species

The open ocean contains a number of threatened, endangered, and other protected species, including whales and small cetaceans, pinnipeds, and sea turtles. These are listed in Table 3-18 for both North Atlantic and North Pacific Ocean areas within the ROI. Many of these species can be found near one or more of the four ranges proposed for conducting OSP launches, but are sometimes seasonal in occurrence

Table 3-18. Protected Marine Mammal and Sea Turtle Species Occurring in the Broad Ocean Area

Common Name	Scientific Name	Federal Status	Pacific Ocean	Atlantic Ocean
Pinnipeds				
Northern fur seal	*Callorhinus ursinus*	MMPA	X	
Guadalupe fur seal	*Arctocephalus townsendi*	T	X	
California sea lion	*Zalophus californianus*	MMPA	X	
Pacific harbor seal	*Phoca vitulina richardsi*	MMPA	X	X
Elephant seal	*Mirounga angustirostris*	MMPA	X	
Steller sea lion	*Eumetopias jubatus*	E, T	X	
Caribbean monk seal [1]	*Monachus tropicalis*	E		X
Gray seal	*Halichoerus grypus*	MMPA		X
Small Cetaceans				
Harbor porpoise	*Phocoena phocoena*	MMPA	X	X
Dall's porpoise	*Phocoenoides dalli*	MMPA	X	
Bottlenose dolphin	*Tursiops truncatus*	MMPA	X	X
Clymene dolphin	*Stenella clymene*	MMPA		X
Common dolphin	*Delphinus delphis*	MMPA	X	X
Striped dolphin	*Stenella coeruleoalba*	MMPA	X	X
Spinner dolphin	*Stenella longirostris*	MMPA		X
Northern right whale dolphin	*Lissodelphis borealis*	MMPA	X	
Risso's dolphin	*Grampus griseus*	MMPA	X	X
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	MMPA	X	
Atlantic white-sided dolphin	*Lagenodelphis acutus*	MMPA		X
Rough-toothed dolphin	*Steno bredanensis*	MMPA		X
Atlantic Spotted dolphin	*Stenella frontalis*	MMPA		X
Pantropical Spotted dolphin	*Stenella attenuata*	MMPA	X	X
Short-finned pilot whale	*Globicephala macrorhynchus*	MMPA	X	X
Long-finned pilot whale	*Globicephala melas*	MMPA		X
Killer whale	*Orcinus orca*	MMPA	X	
False killer whale	*Pseudorca crassidens*	MMPA	X	X
Beaked Whales				
Cuvier's beaked whale	*Ziphius cavirostris*	MMPA	X	X
True's beaked whale	*Mesoplodon mirus*	MMPA		X
Blainville's beaked whale	*Mesoplodon densirstris*	MMPA		X
Sowerby's beaked whale	*Mesoplodon bidens*	MMPA		X
Large Odontocetes and Baleen Whales				
Sperm whale	*Physeter catodon*	E	X	X
Gray whale	*Eschrichtius robustus*	MMPA	X	
Humpback whale	*Megaptera novaeangliae*	E	X	X
Right whale	*Balaena glacialis*	E	X	X
Sei whale	*Balaenoptera borealis*	E	X	
Blue whale	*Balaenoptera musculus*	E	X	
Finback whale	*Balaenoptera physalus*	E	X	X
Bryde's whale	*Balaenoptera edeni*	MMPA	X	
Minke whale	*Balaenoptera acutorostrata*	MMPA	X	
Pygmy Sperm whale	*Kogia breviceps*	MMPA		X
Dwarf Sperm whale	*Kogia simus*	MMPA		X
Northern Bottlenose whale	*Hyperoodon ampullatus*	MMPA		X
Melon-headed whale	*Peponocephala crassidens*	MMPA		X

Table 3-18. Protected Marine Mammal and Sea Turtle Species Occurring in the Broad Ocean Area				
Common Name	**Scientific Name**	**Federal Status**	**Pacific Ocean**	**Atlantic Ocean**
Sea Turtles				
Green sea turtle	*Chelonia mydas*	E, T	X	X
Hawksbill sea turtle	*Eretmochelys imbricata*	E	X	X
Loggerhead sea turtle	*Caretta caretta*	T	X	X
Olive ridley sea turtle	*Lepidochelys oliveacea*	T	X	
Kemp's ridley sea turtle	*Lepidochelys kempii*	E		X
Leatherback sea turtle	*Dermochelys coriacea*	E	X	X

Notes:
MMPA = Protected under the Marine Mammal Protection Act
E = Endangered
T = Threatened
[1] Presumed extinct

because of unique migration patterns. Some species, particularly the larger cetaceans, can occur hundreds or thousands of miles from coastal areas.

3.5.3 ORBITAL AND RE-ENTRY DEBRIS

Man-made orbital debris is a concern as a collision hazard to spacecraft and, with respect to atmospheric re-entry, a potential safety concern for populations on the ground.

3.5.3.1 Orbital Debris

Man-made debris consists of material left in Earth orbit from the launch, deployment, and deactivation of spacecraft. It exists at all inclinations and primarily at LEO altitudes up to 1,080 nmi (2,000 km). Most of the mass of orbital debris is incorporated within the large debris [larger than 4 in (10 cm) in diameter]; though, the quantity of smaller-size debris particles [less than 0.4 in (1.0 cm) in diameter] far exceeds that of the larger debris (Meshishnek, 1995).

Most cataloged orbital debris is found in LEO because of a series of upper-stage explosions that occurred in flight during the late 1970's and early 1980's. The region surrounding geosynchronous orbit, approximately 19,325 nmi (35,790 km) in altitude, also contains a large number of discarded satellites and upper stages. Overall, active payloads account for 6 percent of long-term orbital debris, inactive payloads 22 percent, discarded rocket bodies 17 percent, operational debris released either intentionally (ejection springs, lens caps) or unintentionally (tools) 13 percent, and fragmentation debris accounts for 42 percent (Chobotov, 2001). Fragmentation debris is generated by the explosion of rocket bodies, from the in-space collision and resulting breakup of orbital objects (rocket bodies, payloads, and/or debris).

It is estimated that there are more than 10,000 objects greater than 4 in (10 cm) in size in orbit (most of which are tracked by Air Force Space Command), tens of millions between 0.039 and 4 in (1 to 10 cm) in size, and trillions less than 0.039 in (0.99 mm) in size (NRC, 1995). The quantity of orbital debris has been growing at a roughly linear rate and growth is projected to continue (OSTP, 1995). For the debris population in LEO, for example, the creation rate of debris has outpaced the removal rate, leading to a net growth in the debris population at an average rate of approximately 2 percent each year (CORDS, 1997).

3.5.3.2 Re-entry Debris

Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other orbit perturbing forces. As the object's orbital trajectory draws closer to Earth, its speed increases. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it to either completely or partially burn up during re-entry, and/or fall to Earth. Variations in characterizing orbiting objects (e.g., shape, composition, mass, velocity, altitude, and orbital path), and in the thickness and density of the atmosphere, make decay and re-entry predictions difficult and inexact. [CORDS, 2004; Interagency Group (Space), 1989]

Objects have been re-entering the atmosphere ever since satellites have been launched into space. While re-entry debris reduces the hazard to other satellites and spacecraft still in orbit, it introduces the possibility for debris surviving re-entry to damage property or injure people on the ground. It has been estimated that 10 to 40 percent of a satellite's mass will survive re-entry. However, the risk that an individual will be hit and injured from re-entering debris is extremely low, considering that over the last 40 years, more than 1,400 metric tons of materials are believed to have survived re-entry with no reported casualties. (CORDS, 2004).

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the potential environmental consequences of the Proposed Action and No Action Alternative, described in Chapter 2.0 of this EA, when compared to the affected environment described in Chapter 3.0. The amount of detail presented in each section of the analysis is proportional to the potential for impact. Both *direct* and *indirect* impacts[7] are addressed where applicable. In addition, any *cumulative* effects that might occur are identified later in Section 4.6. Appropriate environmental monitoring and management actions and requirements are also included, where necessary, and summarized in Section 4.7.

A list of all agencies and other personnel consulted as part of this analysis is provided in Chapter 6.0.

4.1 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

The following sections describe the potential environmental consequences of implementing the Proposed Action at Vandenberg AFB, Kodiak Launch Complex, Cape Canaveral AFS, Wallops Flight Facility, and within the global environment.

For the management and implementation of environmental and safety requirements at each of the four ranges, various management controls and engineering systems are already in place. Required by Federal, state, DOD, and agency-specific regulations, these measures are implemented through normal operating procedures. To help ensure that procedures are followed, installation personnel and contractors receive periodic training on applicable environmental and safety requirements. In addition, environmental audits by both internal offices and external agencies are conducted at the ranges to verify compliance.

It is also important to note that before any proposed modification or construction activities at any of the licensed launch sites could take place, it would be necessary for the site operator to obtain a modification of their launch site operator license from the FAA/AST. In addition, any launches proposed at any of the licensed launch sites would require coordination between the licensee and the FAA/AST to ensure that the terms and conditions of the license would be met. Otherwise, a modification to the license would need to be issued.

4.1.1 VANDENBERG AIR FORCE BASE

4.1.1.1 Air Quality

4.1.1.1.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Site modifications and related construction requirements at the base would be limited to just a few facilities, if selected for the OSP. Proposed demolition and construction activities at the ABRES and SLC-4 sites, in particular, would generate fugitive dust from structure removal, ground disturbance, and related operations. Exhaust emissions from trucks and other equipment used during demolition, construction, rocket motor transport, and pre-launch support operations would also occur intermittently. Although no significant PM_{10} emissions are anticipated, standard dust reduction measures would be implemented, including application of water to excavated and graded areas, minimizing vehicle speeds on exposed earth, covering soil stockpiled for more than 2 days, and establishment of a vegetative or other

[7] *Direct* impacts are caused by the action and occur at the same time and place. *Indirect* impacts occur later in time or are farther removed in distance, but are still reasonably foreseeable.

groundcover following completion of project activities. Proper tuning and preventive maintenance of construction and other support vehicles would serve to minimize engine exhaust emissions.

Preparations for the OSP flights would be conducted in compliance with all applicable SBCAPCD rules and regulations, including those that cover the use of any organic solvents (Rule 317), architectural coatings (Rule 323), surface coating of metal parts and products (Rule 330), or sealants (Rule 353).

The loading of hazardous liquid propellants onto the HAPS (if used) and the orbital spacecraft payloads (when propellants are required) would occur in one of the designated payload processing facilities on base. The fuel can be either hydrazine for mono- or bipropellant systems, or MMH for bipropellant systems. The oxidizer used for bipropellant systems is NTO. Each loading operation is independent and sequential, and is conducted using a closed-loop system. During the operation, all propellant liquid and vapors are contained within this closed loop. If small leaks occur during propellant loading, immediate steps are taken to stop loading, correct the leakage, and clean up leaked propellant with approved methods before continuing. Such leakage is absorbed in an inert absorbent material for later disposal as hazardous waste, or aspirated into a neutralizer solution. At the completion of the fueling process, propellant vapors left in the loading system are routed to air emission scrubbers. Liquid propellant left in the loading system is drained either back to supply tanks or into waste drums for disposal as hazardous waste. Prior air emission analyses for similar systems at Vandenberg AFB have not shown any major issues for concern from these fueling operations (NASA, 2002a). If the IRF is used for payload processing, and hydrazine fueling capability is added to the building, similar procedures and emissions control equipment would be applied.

As a result, there should be no violation of air quality standards or health-based standards of non-criteria pollutants during pre-launch activities.

4.1.1.1.2 Flight Activities

Launch activities for the OSP flights also would comply with all applicable SBCAPCD rules and regulations. Under the Proposed Action, up to four MM-derived launches and up to two PK-derived launches per year would occur. The total quantity of exhaust emissions for four MM-derived and two PK-derived launches (for the first three stages only) is provided in Tables 4-1 and 4-2, respectively. Only 1st-stage rocket emissions would normally occur within the ROI for Vandenberg AFB.

During launches out over the ocean, rocket emissions from all stages would be rapidly dispersed and diluted over a large geographic area. Because the launches are short-term, discrete events, the time between launches allows the dispersion of the emission products. The emissions per launch at Vandenberg AFB would be the same for each type of launch vehicle, but the atmospheric concentrations would differ depending on local meteorological conditions at the time of launch, such as temperature profiles, atmospheric stability, wind speeds, and the presence or absence of inversions. However, no violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

In the event of an in-flight problem or malfunction that resulted in either intentional or accidental destruction of the launch vehicle, the rocket motor casing would be split open, releasing internal pressure and terminating propellant combustion, and thus minimizing further emissions.

In regards to Air Quality Conformity, Government rules require that all Federal actions conform to an approved State Implementation Plan or Federal Implementation Plan. Conformity means that an action will not: (1) cause a new violation of the NAAQS, (2) contribute to any frequency or severity of existing NAAQS, or (3) delay the timely attainment of the NAAQS. Conformity applies only to areas that are not

Table 4-1. Exhaust Emissions for Four Minuteman-Derived Launches				
Emission	**1st Stage (tons/year)**	**2nd Stage [1] (tons/year)**	**3rd Stage [2] (tons/year)**	**Total (tons/year)**
Aluminum Oxide (Al_2O_3)	27.74	7.79	2.76	38.28
Carbon Monoxide (CO)	21.97	5.86	2.57	30.40
Carbon Dioxide (CO_2)	3.46	1.27	0.24	4.97
Chlorine (Cl)	0.11	0.04	0.01	0.15
Hydrogen Chloride (HCl)	19.81	6.18	0.27	26.26
Water (H_2O)	8.67	3.43	0.37	12.47
Hydrogen (H_2)	1.92	0.52	0.12	2.56
Nitrogen (N_2)	8.06	2.41	0.97	11.43
Other	0.03	0.01	0.00	0.04

Notes:

[1] Emissions are based on the SR19-AJ-1 motor.

[2] Emissions are based on the M57A-1 motor.

Source: SMC Det 12/RPD, 2005

Table 4-2. Exhaust Emissions for Two Peacekeeper-Derived Launches				
Emission	**1st Stage (tons/year)**	**2nd Stage (tons/year)**	**3rd Stage (tons/year)**	**Total (tons/year)**
Aluminum Oxide (Al_2O_3)	35.34	19.43	5.01	59.77
Carbon Monoxide (CO)	21.79	11.98	5.52	39.29
Carbon Dioxide (CO_2)	2.40	1.32	0.26	3.98
Chlorine (Cl)	0.18	0.10	0.00	0.27
Hydrogen Chloride (HCl)	20.88	11.48	0.24	32.61
Water (H_2O)	7.34	4.03	0.51	11.88
Hydrogen (H_2)	2.20	1.21	0.35	3.75
Nitrogen (N_2)	8.25	4.54	3.77	16.56
Other	0.09	0.05	0.00	0.14

Source: SMC Det 12/RPD, 2005

in attainment with the Federal standards. Because Santa Barbara County has, until recently, been a nonattainment area for the Federal ozone NAAQS, conformity must be considered for NO_x and VOC emissions, which are ozone precursors. In accordance with the CAA, a general Conformity Determination is required when total emissions from the Proposed Action exceed 50 tons (45 metric tons) per year of NO_x or VOC, or the Proposed Action results in more than 10 percent of the County emissions inventory.

Conformity applicability analyses previously conducted for target missile launches at Vandenberg AFB—in support of the Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR)—showed all operations to meet *de minimis* requirements and do not represent a regionally significant action (USASMDC, 2003). The GMD ETR analyses assumed up to five PK target launches per year using the same three-stage booster as the PK-derived launch vehicles proposed under the OSP.

Tables 4-1 and 4-2 show rocket exhaust emissions from four MM-derived and two PK-derived launches per year. Contributions from Pre-Launch Preparations and Post-Launch Operations (e.g., ground vehicle exhaust emissions) for the six OSP missions per year (maximum) would represent approximately 120 percent of the annual emissions associated with five of the target missions under the GMD ETR Program. However, total 1st-stage rocket motor emissions for the six OSP launches (four MM-derived and two PK-derived launches) would represent only about 75 percent of the annual 1st-stage emissions produced by the five PK target launches for the GMD ETR.

Other conformity analyses conducted for NASA's routine payload (spacecraft) processing operations at Vandenberg AFB have shown the resulting emissions to represent a very small fraction (~1/25) of the overall launch operations, and to also be *de minimis* and not regionally significant (NASA, 2002a). NASA's payload processing operations, which include the fueling of spacecraft, are representative of those proposed in support of some of the OSP orbital missions.

Just as for GMD ETR launch operations and NASA's payload processing operations, total emissions associated with the six OSP launches would not exceed the Federal *de minimis* annual limits. In addition, they would not exceed more than 10 percent of the Santa Barbara County emissions identified in Table 3-2. Therefore, further CAA conformity analyses pursuant to 40 CFR Part 51, Subpart W, are not required, and this action does not require a new CAA Conformity Determination. Conformity does not have to be considered for PM_{10} because the area is in attainment with the Federal PM_{10} NAAQS, even though the area is in nonattainment for the more stringent state PM_{10} standard.

4.1.1.1.3 Post-Launch Operations

Post-launch refurbishment activities for the OSP would use paints that meet all applicable SBCAPCD rules, including Rule 323 (architectural coatings) for VOCs. No air emission permits are required for these operations. With the exception of some minor, localized increases in particulate matter from the occasional brushing of blast residues from the launch tube walls at LF-06 and the launch stools elsewhere, no adverse effects on air quality are expected.

4.1.1.2 Noise

4.1.1.2.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Noise exposures from proposed demolition, modification, and construction activities on base (see Table 2-4) are expected to be minimal and short term. If selected, most of the demolition and construction-related noise would occur at the ABRES and/or SLC-4 launch pads and to a lesser extent, at the TP-01 site. The use of heavy construction equipment, power tools, and other machinery (e.g., bulldozers, graders, cranes, jack hammers, and power saws) would generate noise levels ranging from 50 to 95 dB (unweighted) at 164 ft (50 m) (USAF, 2005). If blasting of concrete structures becomes necessary during the demolition work, much higher impulse noise levels would also be generated. Such occurrences, however, would be rare.

The noise generated during pre-launch preparations comes primarily from the use of trucks and other load handling equipment, and is essentially confined to the immediate area surrounding the activities.

For all of these actions, noise exposure levels would need to comply with USAF Hearing Conservation Program requirements, as described earlier in Section 3.1.2, and other applicable occupational health and safety regulations. Because most of the activities would take place on base, the public in the surrounding communities would not detect any increase in noise levels.

4.1.1.2.2 Flight Activities

Noise levels generated by each OSP mission would vary, depending on launch location, launch vehicle configuration, launch trajectory, and weather conditions. Because PK-derived launches generate louder noise levels than MM-derived vehicles, as a result of higher thrust (SRS, 2002), PK and related Athena system[8] launch noise data were used in this analysis to determine impact levels. Figure 4-1 depicts the predicted maximum noise-level contours for each proposed OSP launch site (LF-06, TP-01, ABRES, SLC-4, and SSI CLF). The modeling results depicted in the figure represent a maximum predicted scenario that does not account for variations in weather or terrain. Also, because only MM-derived launch vehicles can be launched from LF-06, noise levels generated from this site would be slightly lower than shown.

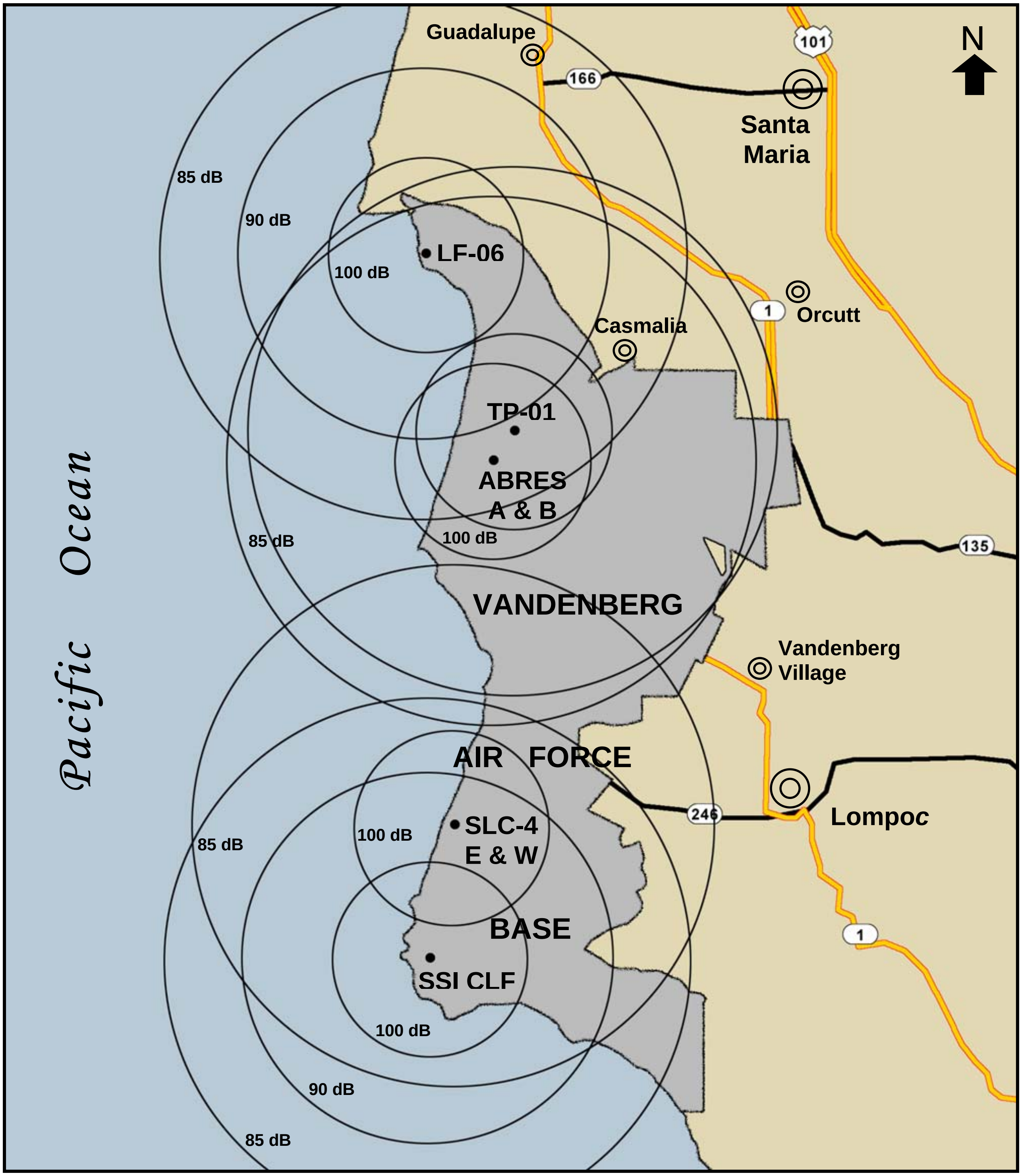
As shown in Figure 4-1, the ASEL generated can range from 100 dB and higher in the vicinity of each launch site, to around 85 dB nearly 8 mi (13 km) away. Launch noise would extend furthest off the base from LF-06, and extend the least amount from the CLF. The City of Guadalupe, for example, may experience a maximum ASEL of around 87 dB for MM-derived launches from LF-06. Launch noise levels from this site would essentially be the same as those produced from prior ICBM test and target launches from LF-06 and other nearby LFs. For the small community of Casmalia, launches from TP-01 or from either ABRES site would result in even higher noise levels—up to approximately 95 dB ASEL for PK-derived launches from TP-01. Such noise levels, however, would be less than those for PK ICBM test launches from LF-02, which is located further north from the TP-01 site.

While these noise exposure levels can be characterized as very loud in some areas, they would occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and have little effect on the CNEL in these areas. Any USAF personnel and contractors working near the area at the time of launch would be required to wear adequate hearing protection in accordance with USAF Hearing Conservation Program requirements. In addition, public access areas near the launch sites would be restricted at the time of launch to ensure public safety and minimize unnecessary exposures. The helicopters used to verify that beach areas and near offshore waters are clear of non-participants generally limit their flights to the areas around the base, thus limiting the noise effects on local communities.

Sonic booms generated by OSP launch vehicles would start reaching the surface some distance downrange of the launch site. These sonic booms generally occur well off the coast over ocean waters. However, in the case of a southerly launch trajectory from the SSI CLF or from either of the SLC-4 sites, the northern Channel Islands could experience sonic booms depending on the flight trajectory used. For launches from the SSI CLF, sonic boom overpressures could reach approximately 1 psf, or 80 dB ASEL, over San Miguel and Santa Rosa Islands (see Figure 4-2) (USAF, 1995). For OSP launches conducted from either of the SLC-4 pads, resulting overpressures would be higher because the launch vehicle would be traveling at a higher velocity as it passes over the islands. Though sonic boom data for such launches is currently unavailable, it is expected that the resulting overpressures would be considerably less than the 10 psf produced by the much larger Titan IV system, or the 7.2 psf expected from the future Atlas V system (USAF, 2000a). The sonic booms would typically be audible for only a few milliseconds, and OSP mission launches from the SSI CLF and/or from the SLC-4 launch sites would occur infrequently.

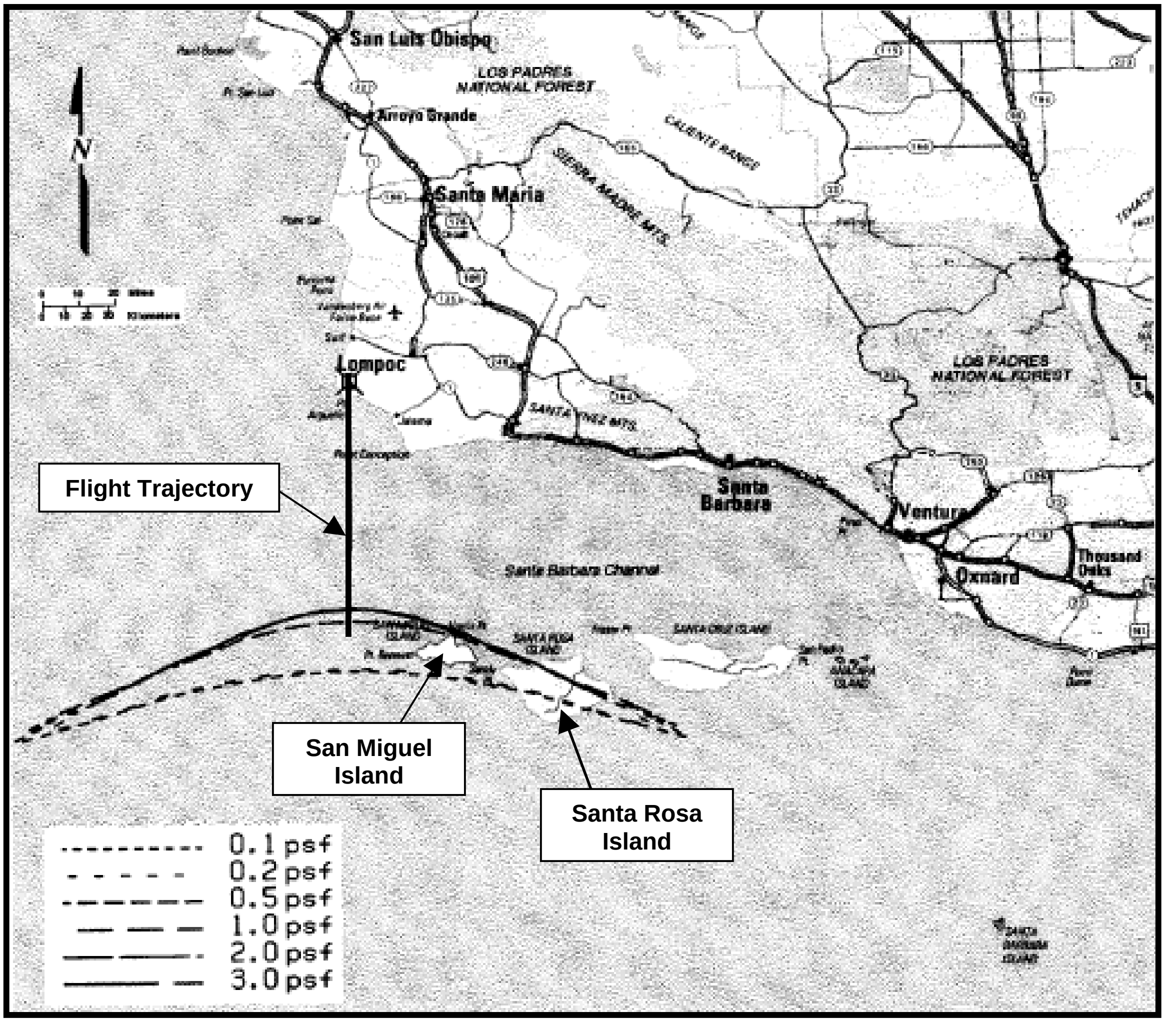
Based on this analysis, the action of conducting up to four MM-derived and two PK-derived launches per year from Vandenberg AFB would have no significant impact on ambient noise levels. The potential for launch noise and sonic boom impacts on protected wildlife species and sensitive habitats is discussed in Sections 4.1.1.3 and 4.1.5.2.

[8] Athena launch vehicles use a Castor 120 as the 1st-stage motor, which is a commercial variant of the PK 1st-stage (SR-118) motor.



Source: Data depicted was extrapolated from Athena and Peacekeeper launch noise data, per ENRI, 2002a; and SRS, 1999, 2002

Figure 4-1. Predicted A-Weighted Sound Exposure Levels for OSP (Peacekeeper-Derived) Launches from Vandenberg AFB, California



Source: Modified from USAF, 1995

Figure 4-2. Predicted Sonic Boom Footprint for a Launch from the SSI Commercial Launch Facility at Vandenberg AFB, California

4.1.1.2.3 Post-Launch Operations

Because of the limited activities associated with post-launch operations, limited amounts of noise would be generated. Thus, no impacts to ambient noise levels are expected.

4.1.1.3 Biological Resources

4.1.1.3.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

At Vandenberg AFB, the intermittent movement of trucks and other load-handling equipment would not produce substantial levels of noise. These activities would be relatively short term and intermittent, and the vehicles and other equipment would normally remain on paved or gravel areas. However, during some of the early demolition and construction phases at the ABRES and/or SLC-4 launch sites, and to a lesser extent at the TP-01 site, heavy construction equipment and other machinery would generate relatively continuous noise, ranging from 50 to 95 dB (unweighted) at 164 ft (50 m) (USAF, 2005). Also, in rare instances, blasting of existing structures may occur, producing very brief, but much higher, impulse noises.

After 14 years or more of disuse, vegetation overgrowth at the TP-01, ABRES-A, and ABRES-B launch sites would require clearing around the launch pad, including inside and immediately outside security fence areas. Construction for utilities, fence lines, and road improvements would also require some grading and limited excavation, but mostly in pre-disturbed areas. Following the completion of construction activities, disturbed areas would be re-vegetated. In the long term, periodic mowing or other vegetation management would be necessary. To ensure that no protected or sensitive plant or animal species are harmed, biological surveys of the affected areas would be completed prior to the start of any clearing or other disturbances.

At the ABRES and SLC-4 launch sites, some of the buildings and structures proposed for demolition and/or modification are currently used as nesting and roosting sites for various bird species, including several species protected under the Migratory Bird Treaty Act (e.g., barn swallows, white-throated swifts, and great-horned owls). A few bat species have also been found to roost in some of the buildings (USAF, 2005). To avoid impacts to these species, surveys would be conducted several months prior to project implementation, before start of the nesting season. Methods to discourage roosting and the initiation of nests, such as the installation of netting or the removal of nesting materials, would be implemented prior to demolition and facility modifications. Existing migratory bird nests, however, would not be removed or destroyed unless determined by a qualified biologist to be inactive.

Overall, it is expected that these activities would not have a significant effect on local vegetation and wildlife, because (1) noise exposures from these activities generally would be short term and localized around existing facilities and along existing roadways; (2) limited areas would be cleared of vegetation, which would occur mostly around existing facilities; and (3) affected areas would be surveyed for protected and other sensitive species prior to project implementation. For these same reasons, the proposed activities are not likely to adversely affect any threatened or endangered species, or critical and other sensitive habitats.

4.1.1.3.2 Flight Activities

Potential issues associated with OSP launch operations include wildlife responses to helicopter activity, wildlife responses and potential injury from excessive launch noise and sonic booms, and the release of potentially harmful chemicals in the form of exhaust emissions. The release of unburned propellant from a possible launch failure or termination is also considered. The potential effects of these actions on the biological resources at Vandenberg AFB and the northern Channel Islands are described in the paragraphs that follow.

Vegetation

Although heat and emissions from rocket exhaust can result in localized foliar scorching and spotting, such effects from larger launch systems have been shown to be temporary and not of sufficient intensity to cause long-term damage to vegetation (NASA, 2002a; USAF, 2000a). As previously mentioned, the areas immediately around active launch sites are kept clear of most vegetation in order to minimize the risk of grass and brush fires. During launch operations, emergency firefighting personnel and equipment would also be on standby status as a protective measure in case of brush fires.

Wildlife

Helicopter Overflights. Base helicopters are flown over the ROI on the day of launch and possibly the day before to ensure launch hazard areas are clear of non-participants. Helicopter overflights have the potential to disturb marine mammals and birds, causing potential loss of eggs when birds fly from nests; separation of pinniped mothers from their offspring; and abandonment of favored resting, feeding, or breeding areas.

Under the terms of the MMPA, as amended, short-term behavioral effects on marine mammals must be considered. According to the MMPA, "harassment" means any act of "pursuit, torment, or annoyance" that has the potential to injure or disturb marine mammals or marine mammal stock. Proposed OSP and other system launches at Vandenberg AFB have the potential to harass marine mammals. To address this issue, base personnel consulted the NOAA Fisheries Service to obtain a programmatic "take" permit. A 5-year take permit was originally issued to Vandenberg AFB in 1997, and was later re-issued in February 2004. Under the permit, the NOAA Fisheries Service is allowed to issue annual Letters of Authorization (LOAs) to Vandenberg AFB for these harassments, which are classified as a small number of "takes" incidental to space vehicle and test flight activities. This allows the base to expose pinnipeds, including breeding harbor seals, to missile and rocket launches, and aircraft flight tests. The programmatic take permit and LOAs also authorize incidental harassment of pinnipeds from helicopter overflights. (69 FR 5720-5728; USAF, 1997a)

Prior observations of helicopter overflights in the launch hazard areas have shown them to be a greater source of disturbance than the launches themselves (Bowles, 2000). Under the current NOAA Fisheries Service permit and LOA, helicopters and other aircraft are required to maintain a minimum distance of 1,000 ft (305 m) from recognized seal haul-outs and rookeries (e.g., Point Sal, Lion's Head, Purisma Point, and Rocky Point) (69 FR 5720-5728). These requirements can be modified only in emergencies, such as during search-and-rescue and firefighting operations. When helicopter flight restrictions are observed, there are negligible impacts on marine mammals and other wildlife.

Launch Noise. Most of the energy in launch noise lies in the range below 1,000 Hertz (Hz), and often below 100 Hz. At low frequencies, pinniped hearing becomes progressively less sensitive (Kastak, et al., 1999), forming the bottom of a "U" shaped curve that is typical of mammal hearing. For humans, the best measures of exposure account for this "U" shape by passing sounds through a filter called A-weighting, which removes low- and high-frequency noise before the level is calculated. The A-weighting function outperforms other functions as a filter where comparisons have been made (e.g., Sullivan and Leatherwood, 1993). It is not known whether similar weighting functions will be good measures of dosage for animals, but the technique has been tested using the harbor seal auditory threshold function and monitoring data being collected at Vandenberg AFB (SRS, 2000a).

Noise levels produced from the SSI CLF, and from other MM- or PK-related launch sites, have been measured from various pinniped haul-out locations at varying distances. As the data in Table 4-3 shows, some monitoring locations have experienced very high noise levels, up to 129 dB ASEL. Under the OSP, a PK-derived launch from the SSI CLF would generate slightly higher noise levels than those shown in the table.

The noise generated by launches from Vandenberg AFB results in the incidental harassment of pinnipeds, both behaviorally and in terms of physiological (auditory) impacts. The noise and visual disturbances from space lift vehicle and missile launches may cause the animals to move towards the water or enter the water. Field surveys have shown that the louder the launch noise, the longer it took for seals to begin returning to the haul-out site and for the numbers to return to pre-launch levels. Seals may begin to return to the haul-out site within 2 to 55 minutes of the launch disturbance, and the haul-out site has usually returned to pre-launch levels within 45 to 120 minutes. No evidence of injury, mortality, or abnormal behavior has been observed for Pacific harbor seals following a launch. (69 FR 5720-5728; SRS, 2000b, 2001a)

Table 4-3. Summary of Launch Noise Measurements at Vandenberg AFB, California				
Launch Facility	Launch Vehicle	Distance from Monitoring Site [1] [mi (km)]	ASEL (dB)	Launch Date
LF-26 [2]	MM ICBM	1.96 (3.15)	100.6	June 7, 2002
LF-05 [3]	PK ICBM	0.4 (0.65)	124.7	September 16, 1997
576-E [4]	Taurus [5]	0.3 (0.5)	123.5 – 128.9	(4 prior launches)
SSI CLF	Minotaur I	1.4 (2.3)	105.4	January 26, 2000
SSI CLF	Minotaur I	1.4 (2.3)	107.0	July 19, 2000
SSI CLF	Minotaur I	1.9 (3.1)	102.2	January 26, 2000

Notes:

[1] Monitoring locations represent the closest pinniped haul-out site in most cases.

[2] LF-26 is located approximately 0.4 mi (0.7 km) north of LF-06.

[3] LF-05 is located approximately 2.1 mi (3.4 km) southeast of LF-06.

[4] 576-E is located approximately 2.9 mi (4.7 km) southwest of ABRES-A, near Purisima Point.

[5] Taurus launch vehicles can be configured with either a Castor 120 or SR-118 (Peacekeeper) as the 1st-stage motor.

Source: 69 FR 5720-5728; SRS, 2000a, 2002

Temporary changes in the animals' hearing threshold [Temporary Threshold Shift (TTS)] are also possible as a result of launch noise. Though TTSs lasting between minutes and hours may be possible, depending on noise exposure levels, indications are that no permanent hearing loss [Permanent Threshold Shift (PTS)] would result. In a study at Vandenberg AFB, TTS was measured in three harbor seals using electrophysiological techniques after they were exposed to a Titan IV launch (SRS, 2000b). One hour after the launch, no TTS could be detected. Measurements were not made within a few minutes of the launch, so it is not known whether small shifts occurred initially or whether the seals would have experienced shifts at higher exposure levels. Similar results have also been shown for Taurus launches from the base (69 FR 5720-5728).

Stress from long-term cumulative sound exposures can result in physiological effects on reproduction, metabolism, and general health, or on the animals' resistance to disease. However, this is not likely to occur because of the infrequent nature and short duration of the launch noise. Research shows that population levels at the pinniped haul-out sites have remained constant in recent years, giving support to this conclusion. (69 FR 5720-5728)

To minimize potential long-term effects of launch noise on pinnipeds, the programmatic take permit requires several measures, including (1) schedule missions, whenever possible, to avoid launches during the harbor seal pupping season (March 1 through June 30), unless constrained by factors including, but not limited to, human safety, national security, or for a space vehicle launch trajectory necessary to meet mission objectives; (2) conduct biological monitoring for all launches during the harbor seal pupping season in accordance with permit procedures, and report the results to the NOAA Fisheries Service; and (3) conduct both acoustic and biological monitoring for all new space and missile launch vehicles during at least the first launch (including an existing vehicle from a new launch site), whether it occurs within the pupping season or not (69 FR 5720-5728). The proposed OSP launches would be conducted in accordance with the measures specified in the programmatic take permit.

The marine mammal programmatic take permit covers a forecast of up to 30 launches per year at Vandenberg AFB (69 FR 5720-5728). The addition of six OSP launches per year (maximum) would not cause the forecast limit to be exceeded (refer to Section 4.3.1 for further discussions on this issue). However, should any of the TP-01, ABRES-A, or ABRES-B launch sites be selected for OSP launches, the USAF would notify the NOAA Fisheries Service accordingly, since none of these particular launch sites were identified in the permit. A formal amendment to the take permit is not expected since the overall OSP launch program is within the parameters already identified in the permit.

As for other non-listed species at Vandenberg AFB, any terrestrial mammals or birds in close proximity to a launch might suffer startle responses and flee the area for some period of time. In addition, any mammal or reptile species (including several Species of Concern) close enough to the launch pad could be subject to TTS effects. However, these effects would be temporary and are not expected to have a significant effect on local populations.

Because of the programmatic take permit measures already in place, and when considering that the OSP launches would represent brief events, would occur infrequently (no more than six times per year), and are unlikely to occur from the same launch site each time, no significant impacts to pinnipeds or to other non-listed wildlife species on base are expected to occur as a result of launch noise.

Sonic Booms. Depending on the strength of the acoustic overpressures generated, sonic boom impulses can impact wildlife in a similar manner as launch noise. This discussion focuses on the potential for sonic boom impacts on wildlife at the northern Channel Islands. For a discussion on potential sonic boom impacts to marine mammals and sea turtles underwater, refer to Section 4.1.5.2.

As identified earlier in Section 4.1.1.2, launches from the SSI CLF and from either of the SLC-4 pads could generate sonic booms over San Miguel and Santa Rosa Islands, depending on the launch trajectory used (see Figure 4-2). Resulting overpressures from CLF launches could reach up to 1 psf or 80 dB ASEL on the islands (USAF, 1995). For launches from the SLC-4 sites, overpressures would be higher, estimated to be between 1 and 7 psf.

Previous monitoring of pinnipeds on the islands has shown that small sonic booms between 1 and 2 psf usually elicit a “heads up” response or slow movement toward and entering the water, particularly for pups. As for effects on hearing thresholds, studies of pinnipeds exposed to sonic boom peak pressures up to 6 psf [equal to 143 dB (referenced to 20 µPa)] have shown no detectable TTS. For even the largest launch vehicles, such as Titan IV and Delta IV, the resulting sonic booms may cause TTS in the animals’ hearing; however, no PTS would be anticipated. (69 FR 5720-5728; USAF, 2001b)

Under the current programmatic take permit for Vandenberg AFB, certain numbers of pinnipeds on the northern Channel Islands may be taken by level B harassment for each launch. The number of pinnipeds allowed to be harassed varies by species, and depends on the type of rocket, location of the sonic boom footprint, weather conditions, the time of day, and the time of year. For these reasons, a wide range of numbers of animals is given for harassment estimates. (69 FR 5720-5728)

As a means of minimizing potential sonic boom impacts to marine mammals on the northern Channel Islands, the programmatic take permit for Vandenberg AFB specifies several measures, including (1) avoid launches, whenever possible, if sonic booms are predicted for the islands during the harbor seal, elephant seal, and California sea lion pupping seasons (March through June), unless constrained by factors including, but not limited to, human safety, national security, or for a space vehicle launch trajectory necessary to meet mission objectives; (2) conduct marine mammal monitoring whenever a sonic boom over 1 psf is predicted to occur over the islands, and report the results to the NOAA Fisheries Service; and (3) obtain acoustic measurements for launch vehicles that have not had sound pressure levels measured previously (69 FR 5720-5728). The proposed OSP launches would be conducted in accordance with the measures specified in the programmatic take permit.

As for other wildlife species, large numbers of migratory seabirds and shorebirds forage, roost, and nest on the islands, particularly on San Miguel and Santa Rosa Islands. As has been reported at other sites (Awbrey, et al., 1991; Schreiber and Schreiber, 1980), birds exposed to repeated sonic booms can become habituated. Birds on the islands may exhibit brief flight responses, but they would not be expected to abandon nests.

Because of the programmatic take permit measures already in place, and when considering that the sonic booms from OSP launches would occur infrequently, produce relatively low overpressures (no greater than 7 psf), and be audible for only a few milliseconds, no significant impacts to pinnipeds or other wildlife on the northern Channel Islands are expected to occur.

Launch Emissions. The atmospheric deposition of launch emissions has the potential to acidify surface waters. The types and quantities of emissions products released from MM-derived and PK-derived launch vehicles are listed in Tables 4-1 and 4-2, respectively. The principal combustion product of concern is hydrogen chloride gas, which forms hydrochloric acid when combined with water.

The acidification of surface waters in some of the small drainages and wetland areas close to some of the launch sites could present harmful conditions for aquatic wildlife and some protected species. The bedrock and, by inference, the soils at Vandenberg AFB do not contain large amounts of acid-neutralizing minerals. However, the close proximity of the proposed launch sites to the ocean, combined with the prevailing onshore winds, causes the deposition of acid-neutralizing sea salt. The alkalinity derived from sea salt should neutralize the acid falling on soil, thus eliminating the potential for acid runoff. Surface water monitoring conducted for larger launch systems on Vandenberg's South Base has not shown long-term acidification of surface waters (USAF, 2000a). Because the OSP launch vehicles are smaller and generally produce fewer exhaust emissions, the potential for adverse effects is minimal.

Launch Failure or Early Flight Termination. In the unlikely event of a failure during launch, or an early termination of flight, the launch vehicle would most likely fall into the ocean reasonably intact, along with some scattered debris. Pieces of unburned solid propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be widely dispersed. Of particular concern is the ammonium perchlorate, which can slowly leach out of the solid propellant resin binding-agent once the propellant enters the water. Studies have shown that the release rate of perchlorate in water is a function of the temperature, salinity, and size of the propellant fragment, with the rate of release being proportional to temperature, and inversely proportional to salinity and size of the fragment (Lang, et al., 2002).

Effects of perchlorate on primary and secondary aquatic production, and on decomposition processes in sediments, wetland peat, and soil material, have recently been subject to laboratory studies. Aquatic primary production was affected only by perchlorate concentrations of 1,000 ppm, and this effect was minimal compared to control samples. Bacterial production was not adversely affected, except at very high levels in seawater samples. Since coastal waters are constantly circulating through wave action and currents, it is unlikely that phytoplankton or bacterioplankton would encounter such high levels of perchlorate for more than a few minutes. (Hines, et al., 2002)

It was also determined from these studies that respiration in marine and freshwater sediments, and in wetland peat, was not adversely affected by perchlorate concentrations as high as 1,000 ppm. However, soil samples exhibited significant decreases in respiration activity in the presence of perchlorate at levels between 100 and 1,000 ppm. Therefore, it is possible that the deposition of perchlorate on coastal soils, following an aborted flight, could decrease the rate that material is decomposed in soil, which could adversely affect the recycling of nutrients and eventual plant growth. (Hines, et al., 2002)

The presence of potassium perchlorate at concentrations up to 10 ppm, and perchlorate concentrations nearing 30 ppm in laboratory aquariums containing solid propellant, had no effect on unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) mating or the birth and growth of fry. Fry mortality occurred in all treatments, but none were statistically different from controls. The laboratory study demonstrated that perchlorate accumulated in both fish and the algal/bacterial community. Although no severe effects of perchlorate stress were detected, it is likely that the continued accumulation of perchlorate would lead to deleterious effects at some level. (Hines, et al., 2002)

In addition to solid propellants in the rocket motors, up to several hundred pounds of liquid propellants contained in an orbital mission payload (spacecraft) and in the HAPS (if used) could also be released on impact, assuming they are not consumed or vaporized during the destruct action. The toxicology of hydrazine, MMH, and NTO with marine life is not well known. NTO almost immediately forms nitric and nitrous acid on contact with water, and would be quickly diluted and buffered by seawater; thus it would have little potential for harm to marine life. With regard to hydrazine fuels, these highly reactive species quickly oxidize, forming amines and amino acids, which are beneficial nutrients to simple marine organisms. Prior to oxidation, there is some potential for exposure of marine life to toxic levels, but for a very limited area and time. (NASA, 2002a)

A lesser hazard may also exist from small amounts of battery electrolyte carried on all launch vehicles and payloads, but the risks from electrolytes are far smaller than for propellants because of smaller quantities, lower toxicity, and the use of more rugged containment systems for batteries (NASA, 2002a).

The probability for an aborted OSP launch to occur is extremely low. If an early abort were to occur, base actions would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby freshwater creeks and wetland areas. Any recovery from deeper coastal waters would be treated on a case-by-case basis. Any liquid or solid propellants remaining in the offshore waters would be subject to constant wave action and currents. The water circulation would, in particular, help to prevent localized build-up of perchlorate concentrations, which has proven to be a slow process. As a result, no significant impacts on biological resources would be expected.

Threatened and Endangered Species

Those threatened and endangered species that could potentially be affected by OSP launches at Vandenberg AFB are listed in Table 4-4 by launch site, and discussed in the paragraphs that follow. Listed pinniped species occurring on the northern Channel Islands are also discussed. Though other listed species occur on Vandenberg AFB, their remoteness from the launch sites makes it very unlikely that they would be adversely affected.

There are three listed plant species located near proposed OSP launch sites: (1) the Federally endangered Gaviota tarplant is found within a mile of the LF-06 and SSI CLF launch sites, (2) the Federally endangered beach layia exists about 2,500 ft (762 m) from the SLC-4 pads, and (3) the state threatened surf thistle occurs within 0.8 mi (1.3 km) of the SSI CLF. Because of their proximity to the launch sites, there is a small risk for these plant species to be affected by the solid rocket motor emissions, particularly hydrogen chloride deposition, which can form hydrochloric acid when dissolved into fog droplets or rainwater, and when deposited directly onto plants. However, the locations of these plant populations should be of sufficient distance from the launch sites to not be a concern. Immediately following launch, the emissions would be rapidly dispersed and diluted over a large area.

Table 4-4. Threatened and Endangered Species Potentially Affected by OSP Launches at Vandenberg AFB, California

Common Name	Federal Status	California Status	Species in Proximity to Launch Sites [1]				
			LF-06	TP-01	ABRES A & B	SLC-4 E & W	SSI CLF
Plants							
Gaviota tarplant	E	E	X				X
Beach layia	E	E				X	
Surf thistle	-	T					X
Fish							
Tidewater goby	E	SC			X		
Unarmored threespine stickleback	E	E			X		
Reptiles/Amphibians							
California red-legged frog	T	SC	X	X	X		X
Birds							
California brown pelican	E	E					X
California least tern	E	E		X	X		
Western snowy plover	T	SC		X	X	X	
Mammals (includes nearshore waters)							
Southern sea otter	T	FP	X				X

Notes:
[1] Designated species are known to occur year round or seasonally within approximately 1.5 mi (2.4 km) of the launch site.
E = Endangered FP = Fully Protected
T = Threatened SC = Species of Concern

The unarmored threespine stickleback occurs along much of the length of San Antonio Creek, which flows westward between the ABRES-A and ABRES-B launch complexes. The tidewater goby is also found in San Antonio Creek, further west near the ocean. Because of the close proximity of the creek to the launch complexes [approximately 800 ft (244 m) from ABRES-A and 2,340 ft (713 m) from ABRES-B], rocket motor emissions could affect the water quality of the creek. Just a slight change in the pH of San Antonio Creek could degrade the habitat for these two species. However, buffering capacity in the creek is expected to dampen any pH changes. In addition, surface water monitoring conducted for larger launch systems on South Vandenberg has not shown long-term acidification of surface waters (USAF, 2000a). Because the OSP launch vehicles are smaller and generally produce fewer exhaust emissions, the potential to adversely affect the water quality of San Antonio Creek is minimal.

The Federally threatened California red-legged frog is commonly found in freshwater ponds and streams around the base, occurring within a few thousand feet of most of the proposed OSP launch sites, including the wastewater ponds northwest of the SSI CLF, approximately 1,600 feet (488 m) away. At such distances, the frogs could be exposed to high launch noise levels (around 125 dB ASEL in some cases) and acidic exhaust products from the solid propellant rocket motor. It is expected, however, that during a launch, the red-legged frogs would dive underwater, where they would be less susceptible to acoustic effects because the sound levels would be attenuated to some degree. Also, as described earlier, the constant deposition of wind-blown sea salt should eliminate the potential for water acidification. Giving support to these conclusions, previous monitoring studies conducted at the wastewater ponds for an Athena 2 launch from SLC-6 (located just north of the SSI CLF) showed no reduction in the number of red-legged frogs, no change in water pH levels, and no change in the acid neutralizing capacity of the water (USFWS, 1999b). Although the OSP launches would potentially disturb red-legged frogs, the earlier biological opinions issued by the USFWS already authorize the incidental harassment of an unspecified number of the frogs as a result of rocket launches (USFWS, 1996, 1998, 1999b).

The sights and sounds of OSP launches and helicopter overflights could affect some of the threatened and endangered bird species found at Vandenberg AFB. Endangered California brown pelicans roost at several shoreline locations near the SSI CLF, the closest being Point Arguello and Rocky Point, each approximately 0.9 mi (1.4 km) away. At this distance, launch of a PK-derived vehicle from the SSI CLF would expose the brown pelicans to ASEL levels near 115 dB. Such sound levels and sight of the launch vehicle may cause brown pelicans roosting in the vicinity to take flight. However, monitoring studies conducted for a 2001 Atlas IIAS launch showed no evidence of injury, mortality, or abnormal behavior in brown pelicans (SRS, 2001b). Also, for an earlier Delta II mission, no differences in brown pelican roosting patterns were observed in the days prior to launch as compared to after the launch (SRS, 2001a). It is expected that security helicopter overflights would have little or no effect as well. Because of the potential for rocket launches and helicopters to disturb brown pelicans, the USFWS, in their 1995 biological opinion for the SSI Commercial Spaceport, authorized the incidental harassment of an unspecified number of the seabirds (USFWS, 1995).

On the coastal dunes along Minuteman Beach, western snowy plovers forage year round and nest from early March through September within 1.5 mi (2.4 km) of the TP-01, ABRES-A, and ABRES-B launch sites. At this distance, the plovers would be subject to brief launch noise ASEL levels up to 110 dB as the launch vehicle passes over on a westerly trajectory. Also, along Surf Beach on South Vandenberg, plover foraging and nesting areas can be found within 0.7 mi (1.1 km) of the SLC-4E and SLC-4W launch pads. Within this shorter distance, some of the shorebirds could experience launch noise ASEL levels between 115 dB and 120 dB. Launch noise and the flash of the rocket engine, especially at night, could startle plovers, causing them to flee the area and their nests. However, observations of flocks of snowy plovers during an Atlas IIAS launch from Vandenberg's SLC-3 launch pad in 2001 showed no interruption of activities, or any evidence of abnormal behavior or injury (SRS, 2001b). In addition, the sights and sounds of OSP launches would be substantially less than that of the much larger Titan IV launch vehicle, which has been launched from SLC-4E since 1991. For comparison, acoustical measurements recorded for an earlier Titan IV mission, taken at the south end of Surf Beach just 1.3 mi (2.1 km) away, indicated that the ASEL level at time of launch was 122 dB (Do, 1994).

In some years, a few nesting pairs of California least terns can be found along the southern end of Minuteman Beach, from San Antonio Creek south. During their nesting season (generally from April 15 to August 31), these shorebirds could also be affected by OSP launches from TP-01, ABRES-A, and ABRES-B. As with nesting snowy plovers, least terns in this area could be startled by the brief launch noise (up to 110 dB ASEL in some areas) and the flash of the rocket engine as the vehicle passes over. For the main colony of least terns near Purisima Point, however, exposures to launches would be substantially lower. Located 2.6 mi (4.2 km) southwest of the ABRES-A launch site, the colony would still experience a launch noise level of approximately 100 dB ASEL, but would not be subject to any overflights. Because of the greater distance from the colony, launch noise levels from the TP-01 and ABRES-B sites would be even less. If TP-01 or either of the ABRES sites are selected for OSP launches, least terns are not expected to abandon nests, as has previously occurred during earlier Delta II launches from the SLC-2 pad (USFWS, 1998). The reasons for this are (1) the OSP launch sites are located further away from least tern nesting habitat [for comparison, SLC-2 is within 0.5 mi (0.8 km) of nesting habitat], (2) there would be no OSP launch vehicle overflights of the least tern colony at Purisima Point, (3) the PK-derived launch vehicle proposed for OSP would generate slightly lower noise levels and for a shorter duration, and (4) no more than two OSP launches per year would occur from any of the three proposed launch sites. To minimize the potential for impacts on both least terns and snowy plovers, the OSP would adopt the terms of the USFWS's earlier biological opinion for the TP-01 and ABRES launch sites, which specifies avoidance of night and low-light launches to the extent possible (USFWS, 1998).

Because helicopters and other aircraft can also disturb California least terns and Western snowy plovers, Vandenberg AFB has implemented requirements for all aircraft to maintain a slant distance of not less than 1,900 ft (579 m) from nesting areas (from March 1 through September 30), and a year-round minimum 500 ft (152 m) slant distance from all identified snowy plover habitat areas on base (VAFB, 2002). Just as described earlier for pinniped haul-outs and rookeries, these requirements can be modified only for emergency purposes. By observing these aircraft restrictions, it is expected that no adverse effects would occur to these listed bird species. Although the OSP launches and helicopter overflights would potentially disturb least terns and snowy plovers, the USFWS, in their 1998 biological opinion for the TP-01 and ABRES launch sites, have already authorized the incidental harassment of an unspecified number of the shorebirds because of similar launch operations (USFWS, 1998).

As previously described, southern sea otter colonies are found in the offshore waters along the South Vandenberg coastline, less than 2 mi (3.2 km) from the SSI CLF. Semi-migratory individuals are also seen near Point Sal, within 2 mi (3.2 km) of LF-06. At these distances, the animals could be exposed to surface launch noise just over 100 dB ASEL. Such events might cause the animals to suffer startle responses and retreat underwater temporarily. At such sound pressure levels, however, it is unlikely that the animals would experience TTS effects, particularly when submerged. Monitoring of sea otters for an earlier Delta II launch showed no evidence of injury, mortality, mother-pup separation, or other abnormal behavior, even when exposed to launch noise ASEL levels of approximately 115 dB (SRS, 2001a). Any helicopter overflights close to the otters could also startle the animals, but again, the effects would be temporary. Because rocket launches and helicopter overflights can potentially disturb southern sea otters, the USFWS has, in their earlier biological opinions, authorized the incidental harassment of an unspecified number of the animals (USFWS, 1995, 1998).

Within the northern Channel Islands, there would be little chance for listed Guadalupe fur seals and Steller sea lions to be affected by sonic booms because (1) these species are only occasional or rare visitors to San Miguel Island; (2) Vandenberg AFB has programmatic take permit measures for marine mammals already in place (refer to earlier discussions); and (3) sonic booms from OSP launches would occur infrequently, produce relatively low overpressures (no greater than 7 psf), and be audible for only a few milliseconds. To address the potential for sonic booms to disturb these two species, the take permit authorizes the incidental harassment of two Guadalupe fur seals and one Steller sea lion during the permit period (69 FR 5720-5728).

To minimize potential long-term impacts on Federally threatened and endangered species at Vandenberg AFB, monitoring requirements would be conducted for OSP launches, in accordance with the existing USFWS biological opinions and base monitoring plan that are listed below, by launch site:

- **LF-06, TP-01, ABRES-A, and ABRES-B Launch Sites**
  - *Biological Opinion for the Theater Missile Targets Program, Vandenberg Air Force Base, Santa Barbara County, California* (USFWS, 1998)
  - *Final Threatened/Endangered Species Monitoring Plan for the Theater Ballistic Missile Targets Program* (VAFB, 1999)

- **SLC-4E and SLC-4W Launch Sites**
  - *Biological Opinion for the Titan Space Launch Program from Space Launch Complex 4, Vandenberg Air Force Base, California* (USFWS, 1996)

- **SSI CLF Launch Site**
  - *Biological Opinion for the California Spaceport, Vandenberg Air Force Base, Santa Barbara County, California* (USFWS, 1995)
  - *Biological Opinion for the Spaceport Launch Program, Vandenberg Air Force Base, Santa Barbara County, California* (USFWS, 1999b)

It is important to note that in the preparation of this OSP EA, the design plans for the ABRES and SLC-4 sites were not available, and the plans are not expected until additional engineering and operational concept studies are completed. Thus, should any of the ABRES or SLC-4 sites be selected for OSP missions, additional NEPA analyses may be required prior to initiating construction activities and launch operations. In addition to such analyses, coordination and consultations with the USFWS and NOAA Fisheries Service would be conducted, as necessary. However, no requirement for formal agency consultation for the proposed OSP is anticipated, because OSP launch-related impacts on Federally listed species and marine mammals would not exceed those already addressed under existing USFWS biological opinions and the NOAA Fisheries Service programmatic marine mammal take permit.

In summary, the proposed OSP launches may cause short-term effects on some Federal and state threatened or endangered species; however, the launches are not likely to adversely affect the long-term well-being, reproduction rates, or survival of any of these species. The measures and monitoring requirements already in place at Vandenberg AFB would be incorporated into OSP launch operations to minimize potential impacts on listed species.

Environmentally Sensitive and Critical Habitats

OSP launches conducted from the TP-01, ABRES-A, and/or ABRES-B launch sites would fly west over the coastal dune system, but are not expected to have any adverse effects on the dunes. Should a launch anomaly result in any debris impacting in the dunes, appropriate methods of recovery would be used that minimize surface disturbance (e.g., limited use of vehicles and heavy equipment within the dunes).

Known habitat areas for the Gaviota tarplant, Lompoc yerba santa, and other protected plant species would not be adversely affected by normal launch operations from any of the proposed launch sites. However, in the rare case of a launch anomaly, should any debris impact near or within habitat areas, the base botanist and/or other biologists would assist in recovery operations by surveying the impact area in order to avoid or minimize damage to protected plant species. Emergency firefighting personnel and equipment would also be on standby status as a protective measure in case of brush fires.

Western snowy plover critical habitat is located along Minuteman Beach, about 1.5 mi (2.4 km) west of the TP-01, ABRES-A, and ABRES-B launch sites (see Figure 3-2). At this distance, portions of the critical habitat area would be subject to brief noise levels up to 110 dB ASEL, but otherwise would not be adversely affected by launch vehicle overflights. On South Vandenberg, the southern tip of snowy plover critical habitat along Surf Beach is within 0.7 mi (1.1 km) of the SLC-4E and SLC-4W launch pads. Launch noise here could exceed 115 dB ASEL, but again, the critical habitat is not likely to be adversely affected by overflights. In the unlikely event that launch debris would impact within the critical habitat areas, particularly during the nesting season, the base wildlife biologist would assist in recovery operations by surveying the impact area in order to avoid or minimize damage to nesting sites. Just as described for potential debris impacts within the coastal dunes, appropriate methods of recovery would be used that minimize surface disturbance.

Though a few California least terns may also occur along the southern end of Minuteman Beach, they are most prominent at the least tern colony immediately south of Purisima Point. Located 2.6 mi (4.2 km) southwest of the ABRES-A launch site, the closest OSP launch site proposed, this nesting area would experience launch noise levels of approximately 100 dB ASEL, but would not be subject to any overflights or other disturbance. Also, as described earlier, helicopters used to survey launch hazard areas must maintain minimum slant distances during flights near least tern and snowy plover habitat areas (VAFB, 2002). As a result, proposed OSP launch operations are not likely to have an adverse effect on either the least tern or snowy plover habitat areas.

Launches from the SSI CLF would travel directly over the Vandenberg Marine Ecological Reserve, resulting in noise levels close to 110 dB ASEL over the Reserve waters. Such brief noise levels, however, are not expected to cause behavioral changes in the wildlife found in these areas. Depending on the launch azimuth used, launches from either of the SLC-4 sites could also pass over the Reserve, but at a much higher altitude and with significantly lower noise levels at the ocean surface.

Located about 35 mi (56 km) southeast of Vandenberg AFB, the northern Channel Islands could be subjected to sonic booms up to 1 psf from launches out of the SSI CLF, depending on the launch azimuths used. For southerly launches out of either of the SLC-4 launch pads, higher sonic boom overpressures (estimated to be between 1 and 7 psf) could occur over the islands. Considering that the sonic booms would last only several milliseconds and would occur infrequently, wildlife found within the Channel Islands National Park and the Channel Islands National Marine Sanctuary are not expected to suffer any long-term adverse effects.

Per earlier discussions, rocket launch emissions would not impact the water quality of local surface waters. If a launch anomaly were to occur, actions at Vandenberg AFB would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials that had fallen on the ground or in any of the wetlands and shoreline areas. Any recovery operations in deeper coastal waters, however, would be treated on a case-by-case basis. As a result, no significant impacts to wetlands, the Vandenberg Marine Ecological Reserve, or to EFH areas would occur.

4.1.1.3.3 Post-Launch Operations

The intermittent movement of trucks and any repair/clean-up/waste-handling equipment would not produce substantial levels of noise, and vehicles normally would remain on paved or gravel areas. Thus, the limited actions associated with post-launch operations would have no adverse effects on local vegetation or wildlife, including threatened and endangered species, and critical and other environmentally sensitive habitats.

4.1.1.4 Cultural Resources

4.1.1.4.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Archaeological Sites

The site modifications proposed at Vandenberg AFB would require limited ground disturbance, mostly in pre-disturbed areas. Any excavation and grading for fencing, utility lines, road modifications and upgrades, or other structural changes are not expected to disturb known archaeological sites. For those facilities selected for OSP operations that are in the vicinity of known archaeological sites, site modifications and related construction activities would be tailored to ensure that the archaeological resource areas are avoided.

Any OSP-related activities that would occur within 200 ft (61 m) of a known archaeological site would require boundary testing to ensure that portions of the site are not inadvertently disturbed. Any archaeological site or potential site where tested boundaries are within 100 ft (30 m) of the project would require monitoring by archaeologists and/or Native American specialists during earth disturbing activities. In the unlikely event that previously undocumented sites are discovered during the execution of the proposed action, work would be temporarily suspended within 100 ft (30 m) of the discovered item and the base archaeologist would immediately be notified. Work would not resume until after the site has been secured and properly evaluated.

The OSP would be responsible for implementation of any required avoidance of archaeological sites, or other mitigation measures, assigned to the project as a condition of approval for the activity by Vandenberg AFB and the California SHPO. These measures may include, but are not limited to, having an archaeologist and/or Native American specialist present during site preparation activities, flagging or fencing to protect cultural resources, archaeological testing, data recovery, and report preparation. OSP contractors and base support personnel would be informed of the sensitivity of cultural resources and the mitigation measures that might be required if sites are inadvertently damaged or destroyed. Archaeological and Native American monitors would be required for most ground-disturbing activities associated with OSP projects because of close proximity of sensitive resources.

The impacts associated with trenching/digging have the greatest potential for harm to archaeological resources. In most situations, trenching operations, if required, would be restricted to previously disturbed road shoulders and existing utility corridors. In cases where new utilities or fences would be installed in routes away from road shoulders and existing utility corridors, the routes would be designed to avoid sensitive areas by a minimum of 100 ft (30 m). The use of other installation methods such as slant/directional drilling under known archaeological sites could further minimize the potential for impacts to cultural resources. Slant/directional drilling would begin at a minimum of 100 ft (30 m) from the established boundary of known archaeological sites. Any required cable installation would not have an adverse impact on known archaeological deposits.

Unauthorized artifact collection by OSP personnel has the potential to adversely affect nearby archaeological sites. Workers would not be notified of the location of nearby sites unless the sites are to be specifically avoided by OSP activities. OSP contractors and base support personnel would be informed of the sensitivity of cultural resources and the mitigation measures that might be required if sites are inadvertently damaged or destroyed. Thus, no impacts to archaeological sites or historic buildings are expected.

The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at the base. In some situations, heavy transport vehicles could potentially harm subsurface resources when moving missiles and missile components to and from the launch and other facilities. However, these are routine activities at Vandenberg AFB. Transport vehicles would remain on paved or gravel areas and would not disturb archaeological sites by traveling off road.

Several of the proposed launch sites are active, or recently active, facilities, with vegetation maintenance programs in place. TP-01, ABRES-A, and ABRES-B, however, have had little maintenance in years and suffer from overgrowth of vegetation. Vegetation inside and immediately outside perimeter fences would require clearing to minimize fire hazards from launches and for security purposes. Vandenberg AFB currently applies both mowers and disk harrows for clearing, depending on how heavy and invasive the vegetation is. However, disk harrows would not be used for clearing and maintenance in the vicinity of known archaeological sites.

Historic Buildings and Structures

Four facilities that would potentially be used for the OSP have been determined to be eligible for listing on the NRHP for their Cold War, ICBM Program historic context. These are LF-06; and Buildings 1819, 1886, and 1900. Of these, only one—Building 1900—would potentially be altered or modified for use in support of the OSP. LF-06, Building 1819, and Building 1886 would not be modified if they are used for OSP activities. The modifications to Building 1900 would include heightening the main bay access door several feet, attaching rails and anchors to the main bay floor, and adding hydrazine fueling capability. However, Building 1900 was one of several facilities that have recently undergone Historic American Engineering Record (HAER) documentation for the Ground-Based Interceptor Program. Any modifications to Building 1900 would be mitigated by the HAER recordation. Though the buildings would be used in support of the new OSP program, the types of activities proposed to occur in them would be similar to that of the earlier MM and PK ICBM support programs.

Within the ABRES-A launch complex, Building 1788 is potentially eligible for listing on the NRHP. If selected to support OSP launches, modification and use of Building 1788 would require Section 106 consultation with the California SHPO, and any mitigation measures negotiated with the SHPO for such use would have to be adhered to.

4.1.1.4.2 Flight Activities

No additional ground disturbance or facility modification would occur during flight activities. Thus, no impacts to archaeological sites or historic buildings are expected from nominal flight activities.

However, falling debris from a flight termination or other launch anomaly could strike areas on the ground where surface or subsurface archaeological deposits, or other cultural resources, are located. This could result in soil contamination, fire, and/or resource damage, which would all require a reparation effort. With the potential for fires to occur, firefighting activities can also damage subsurface historic and prehistoric archaeological sites. In the unlikely event that a mishap occurs, post-mishap recommendations would include post-event surveying, mapping, photography, and site recordation to determine and record the extent of the damage. These efforts would be coordinated with applicable range representatives and the California SHPO to develop the most appropriate mitigation measures based on the nature of the mishap and the cultural resources involved. Any debris falling offshore would not pose a threat to cultural resources on base.

4.1.1.4.3 Post-Launch Operations

Because of the limited activities associated with post-launch operations, no additional ground disturbance or facility modification would occur. However, because OSP personnel would be on site during cleanup and site maintenance, the potential for unauthorized artifact collection still exists. Again, OSP personnel would be reminded of the sensitivity of cultural resources and the issues of inadvertently damaging or destroying such resources. Thus, no impacts to archaeological sites or historic buildings are expected to occur.

4.1.1.5 Health and Safety

4.1.1.5.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

For proposed demolition and construction activities on base, workers, including both military personnel and contractors, would be required to comply with applicable AFOSH and OSHA regulations and standards.

The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at the base. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations within 29 CFR, would be followed, as well as all appropriate DOD and USAF regulations. The handling of large rocket motors, liquid propellants, and other vehicle ordnance is a hazardous operation that requires special care and training of personnel. By adhering to the established and proven safety standards and procedures identified in Section 3.1.5, the level of risk to military personnel, contractors, and the general public would be minimal.

Whether the rocket motors and other ordnance are transported by road, rail, or air, the transportation systems used would provide environmental protection and physical security to the components. Heavily constructed trailers, carriages, and/or containers would be used to safely transport the motors. All transportation and handling requirements for the rocket motors and other ordnance would be accomplished in accordance with DOD, USAF, and DOT policies and regulations to safeguard the materials from fire or other mishap. As described in Section 3.1.5, accident rates for ongoing operations involving rocket motor transportation have historically been very low.

Regarding any radioisotopes that might be used on spacecraft payloads, the amounts would be limited to small quantities, typically a few millicuries, and the materials would be encapsulated and installed onto the spacecraft prior to arrival at the range. Because of the small amount of material used and the safety precautions in place, the use of radiological materials in payloads would result in minimal health and safety risks.

Most spacecraft payloads would be equipped with radar, telemetry, and tracking system transmitters. To avoid potential non-ionizing radiation impacts, any ground tests of such systems prior to launch would comply with Institute of Electrical and Electronic Engineers (IEEE) 95.1-1991 (*IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*) standards and applicable USAF standards for limiting human exposure to radio frequency electromagnetic fields. Following launch and orbit insertion, such systems would present no radiation hazard to populated regions or to aircraft.

In addition, any spacecraft equipped with laser instruments must adhere to ANSI Z136.1-2000 (*American National Standard for Safe Use of Lasers*) and ANSI Z136.6-2000 (*Safe Use of Lasers Outdoors*), as well as applicable Federal and state OSHA regulations regarding laser use. Should any ground tests of laser instruments be required prior to launch, only trained personnel would operate the laser systems, and personnel in close proximity to laser activities would wear appropriate personal protective equipment. In addition to eye and skin hazards, ANSI Z136.6-2000 also requires visible lasers, used outdoors, to cause no interference with other spacecraft and aircraft operations.

Consequently, no significant impacts to health and safety are expected.

4.1.1.5.2 Flight Activities

Adherence to the policies and procedures identified in Section 3.1.5 protects the health and safety of on-site personnel. The establishment of Launch Hazard Areas (LHAs), impact debris corridors, beach and access road closures, and the coordination and monitoring of train traffic passing through the base, in addition to the NOTMARs and NOTAMs published for mariners and pilots, serves to protect the public health and safety. In support of each mission, a safety analysis would be conducted prior to launch activities to identify and evaluate potential hazards and reduce the associated risks to a level acceptable to Range Safety. For each rocket launch from the Western Range, the allowable public risk limit for launch-related debris (from liftoff through to orbit insertion) is extremely low, as the following AFSPCMAN 91-710 and RCC 321-02 Supplement criteria show:

- Casualty expectation for all mission activities shall be less than 1 in 1,000,000 for individual risk, and less than 30 in 1,000,000 for collective risk (i.e., the combined risk to all individuals exposed to the hazard);

- Probability of impacting a ship shall be less than 1 in 100,000;

- Using containment areas [9], the probability of impacting an aircraft is essentially zero (AFSPC, 2004; RCC, 2002).

For comparison purposes, the average annual probability of fatality from accidents in the home is 1.02 in 10,000 per individual. This includes falls, fire and burns, drowning, electrical shock, and other home-related events (RCC, 2002). Thus, the risk of fatality to the public from OSP launches at Vandenberg AFB would be significantly less than the risk from accidents occurring in the home.

As a result, no significant impacts to health and safety are expected.

4.1.1.5.3 Post-Launch Operations

Post-launch refurbishment and blast residue removal are routine operations at Vandenberg AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate DOD and USAF regulations. By adhering to the established safety standards and procedures identified in Section 3.1.5, the level of risk to military personnel, contractors, and the general public would be minimal. Consequently, no significant impacts to health and safety are expected.

4.1.1.6 Hazardous Materials and Waste Management

4.1.1.6.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Site modifications proposed for the SLC-4 launch pads and the ABRES complexes would avoid any damage or interference with existing IRP treatment and monitoring systems. Modifications and related demolition activities to some buildings and facilities—primarily at TP-01, ABRES-A, ABRES-B, SLC-4E, SLC-4W, and/or the IRF—might require surveys for asbestos, lead-based paint, and PCB ballasts if such information is not already available. Any removal of hazardous materials from the buildings and facilities would require containerizing and proper disposal at the Base Landfill or at other permitted facilities located off base.

The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at Vandenberg AFB. During pre-flight preparations, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.6. As an example, key elements in the management of liquid propellants for spacecraft would include material compatibility, security, leak detection and monitoring, spill control, personnel training, and specific spill-prevention mechanisms.

All hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable Federal, state, local, DOD, and USAF regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change.

[9] Normally, containment is achieved by constraining launch operations or by closing airtraffic lanes through agreements with the FAA.

4.1.1.6.2 Flight Activities

Flight activities normally would not utilize any hazardous materials or generate any hazardous waste. If an early launch abort were to occur, base actions would immediately be taken to recover unburned propellants (solid or liquid) and any other hazardous materials that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby freshwater creeks. Any recovery from deeper water along the shoreline would be treated on a case-by-case basis. Any waste materials collected would be properly disposed of in accordance with applicable regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.1.6.3 Post-Launch Operations

The post-launch refurbishment and blast residue removal are all routine activities at Vandenberg AFB. During this process, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.6. All hazardous and non-hazardous wastes, including industrial wastewater from launch pad catchments, would be properly disposed of, in accordance with applicable Federal, state, local, DOD, and USAF regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.2 KODIAK LAUNCH COMPLEX

4.1.2.1 Air Quality

4.1.2.1.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

No OSP-related construction activities are planned for Kodiak Launch Complex. Emissions from trucks and other equipment used during rocket motor transport and pre-launch support operations should have no measurable impact on regional air quality.

Similar to that described for Vandenberg AFB under Section 4.1.1.1, the loading of liquid propellants onto the HAPS and orbital spacecraft payloads may be required at either the Integration and Processing Facility, or the Payload Processing Facility. However, because of operating procedures in place, and the use of closed-loop fueling systems with air emission scrubbers, the amount of emissions from such operations at Kodiak Launch Complex would be very small. Based on prior air emission analyses for similar systems, no significant impacts on air quality are expected during these fueling operations (NASA, 2002a).

4.1.2.1.2 Flight Activities

Launch activities for the OSP flights at Kodiak Launch Complex would have very similar impacts as those described earlier in Section 4.1.1.1 for Vandenberg AFB. The total quantity of exhaust emissions for four MM-derived launches is shown in Table 4-1. Quantities of exhaust emissions for up to two PK-derived launches are provided in Table 4-2. Only 1st-stage rocket emissions would normally occur within the ROI for Kodiak Launch Complex.

During launches out over the ocean, rocket emissions from all stages would be rapidly dispersed and diluted over a large geographic area. Because the launches are short-term discrete events, the time between launches allows the dispersion of the emission products. The emissions per launch at Kodiak Launch Complex would be the same for each type of launch vehicle, but the atmospheric concentrations would differ depending on local meteorological conditions at the time of launch, such as temperature profiles, atmospheric stability, wind speeds, and the presence or absence of inversions. However, no violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

Because Kodiak Island Borough is in full attainment with the NAAQS, no CAA Conformity Determination is required. OSP activities would not jeopardize the attainment status for the region.

4.1.2.1.3 Post-Launch Operations

Equipment repairs, cleaning of blast residues, and repainting (as necessary) would generate minimal emissions. As a result, little or no adverse effects on air quality are expected from post-launch activities.

4.1.2.2 Noise

4.1.2.2.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

No construction or facility modifications would be necessary for OSP launches from Kodiak Launch Complex. The minimal noise generated during pre-launch preparations comes primarily from the use of trucks and other load handling equipment, and is essentially confined to the immediate area surrounding the activities. Any noise exposure levels would comply with OSHA regulatory requirements. Other than some increased traffic on local roads, the nearby public areas and residence would not detect any increase in noise levels.

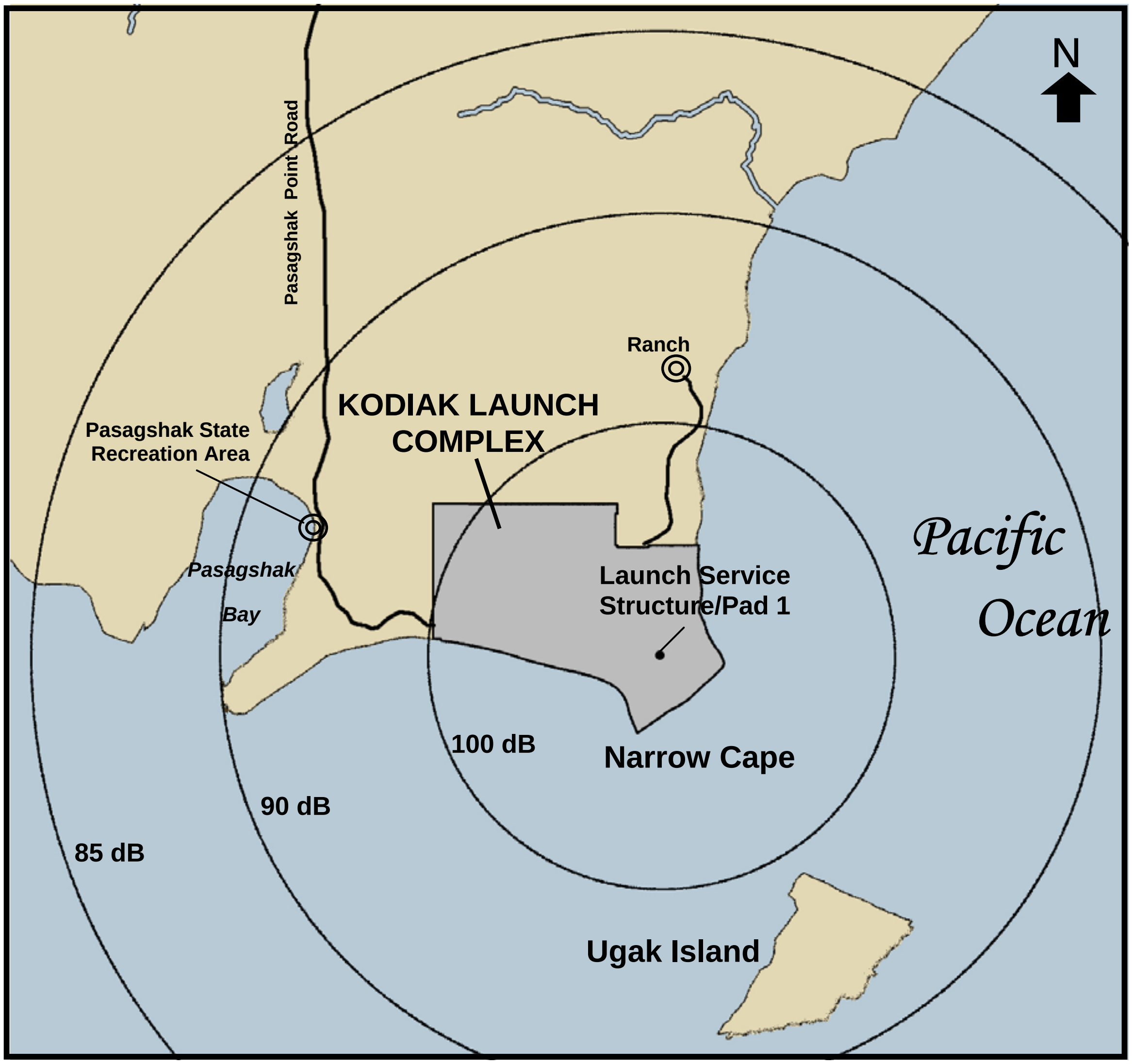
4.1.2.2.2 Flight Activities

Noise levels generated by each OSP mission would vary, depending on the launch vehicle configuration, launch trajectory, and weather conditions. Because PK-derived launches generate louder noise levels than MM-derived vehicles, because of higher thrust (SRS, 2002), PK and related Athena system launch noise data were used in this analysis to determine impact levels. Figure 4-3 depicts the predicted maximum noise-level contours for a proposed OSP launch from the Launch Service Structure/Pad 1. The modeling results depicted in the figure represent a maximum predicted scenario that does not account for variations in weather or terrain. As shown in Figure 4-3, the ASEL generated can range from 100 dB and higher on Kodiak Launch Complex, to around 85 dB nearly 8 mi (13 km) away. At the northern spit of Ugak Island, noise levels could reach near 100 dB ASEL.

Kodiak Launch Complex workers would normally be at the Launch Control and Management Center during launches, approximately 2.0 mi (3.2 km) from the launch pad. Workers subject to excessive launch noise would be required to wear adequate hearing protection in accordance with OSHA regulations.

Outside the complex, the nearby ranch and the Pasagshak State Recreation Area could be subject to noise levels up to 95 dB ASEL. While these noise exposure levels can be characterized as very loud in some areas, they would occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and would be well within the OSHA standard of 115 dBA over 15 minutes [29 CFR 1910.95(b)(2)] for permissible noise exposures.

Sonic booms generated by OSP launch vehicles would start reaching the surface some distance downrange of the launch site. These sonic booms generally occur well off the coast over ocean waters, and so are not an issue affecting coastal land areas or other islands. In addition, the sonic booms are typically audible for only a few milliseconds.



Source: Data depicted was extrapolated from Athena and Peacekeeper launch noise data, per ENRI, 2002a; and SRS, 1999, 2002

Figure 4-3. Predicted A-Weighted Sound Exposure Levels for OSP (Peacekeeper-Derived) Launches from Kodiak Launch Complex, Alaska

Based on this analysis, the action of conducting up to four MM-derived and two PK-derived launches per year from Kodiak Launch Complex would have no significant impact on ambient noise levels. The potential for launch noise and sonic boom impacts on protected wildlife species and sensitive habitats is discussed in Sections 4.1.2.3 and 4.1.5.2.

4.1.2.2.3 Post-Launch Operations

Because of the limited activities associated with post-launch operations, limited amounts of noise would be generated. Thus, no impacts to ambient noise levels are expected.

4.1.2.3 Biological Resources

4.1.2.3.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

No construction or facility modifications would be necessary for OSP launches from Kodiak Launch Complex. For the limited actions associated with pre-launch preparations on the complex, the intermittent movement of trucks and other load-handling equipment would not produce substantial levels of noise. These activities would be relatively short term, and vehicles and other equipment would normally remain on paved or gravel areas.

Thus, it is expected that these activities would have little or no adverse effects on local vegetation and wildlife, including threatened and endangered species, and critical and other environmentally sensitive habitats.

4.1.2.3.2 Flight Activities

Potential issues associated with OSP launch operations include wildlife responses and potential injury from excessive launch noise, and the release of potentially harmful chemicals in the form of exhaust emissions. The release of unburned propellant from a possible launch failure or termination is also considered. The potential effects of these actions on the biological resources at Kodiak Launch Complex and Ugak Island are described in the paragraphs that follow.

Vegetation

During a launch, the exhaust heat and atmospheric deposition of emissions has the potential to harm nearby vegetation. Although localized foliar scorching and spotting is possible, such effects from larger launch systems have been shown to be temporary and not of sufficient intensity to cause long-term damage to vegetation (NASA, 2002a; USAF, 2000a). As previously mentioned, the area immediately around the launch pad is kept clear of most vegetation in order to minimize the risk of brush fires.

Wildlife

Launch Noise. As mentioned earlier, several rocket launches have been conducted from Kodiak Launch Complex; the Athena system being the largest vehicle launched and licensed at the facility. Based on the OSP mission noise predictions shown in Figure 4-3, shoreline areas of the complex could experience launch noise levels ranging from 115 to 120 dB ASEL, while Ugak Island could be subject to an ASEL up to approximately 100 dB. Monitoring studies conducted at the northern spit of Ugak [about 3.5 mi (5.6 km) from the launch site] have previously recorded ASELs ranging from 80 dB for the QRLV to 101 dB for the Athena (ENRI, 2001, 2002a), which uses a 1st-stage motor (Castor 120) similar to that proposed for use on the PK-derived systems.

The noise generated by launches from the Kodiak Launch Complex could result in short-term behavioral and/or auditory impacts for pinnipeds on Ugak Island. The noise and visual disturbances from launch vehicles can cause the animals to move towards the water or enter the water. However, as previously described for Vandenberg AFB (Section 4.1.1.3), seals may begin to return to haul-out sites within 2 to 55 minutes of the launch disturbance, with numbers returning to pre-launch levels within 45 to 120 minutes. Monitoring studies conducted at Vandenberg AFB have shown no evidence of mother-pup separation in Pacific harbor seals (69 FR 5720-5728; USASMDC, 2003). Also, no TTS or PTS occurrences in pinnipeds would be expected, since animals on Ugak are not likely to be exposed to ASEL levels over 100 dB. Steller sea lions hauled out on the northern spit of Ugak Island (see Figure 3-3) would probably be the only pinnipeds affected by launches. Pacific harbor seals found mostly on the southeast side of

Ugak Island are already subject to high ambient noise levels from heavy surf, and are sheltered from Kodiak Launch Complex by a 300 ft (91 m) cliff (69 FR 63114-63122).

In terms of impacts on other wildlife species, monitoring studies conducted along the coastline for sea and shore birds, including harlequin ducks (*Histrionicus histrionicus*), black scoters (*Melanitta nigra*), and various gull species, strongly suggest that rocket launches do not have a significant effect on bird habitat use patterns within the Narrow Cape area. The formal requirement for monitoring sea duck and bald eagle reactions to launches was ended by the USFWS in 2004 after review of data from past rocket launches, which showed that launch operations were not adversely affecting these species. However, as a precaution, the AADC will continue to document bald eagle behaviors at the nesting site on Narrow Cape immediately down range from the launch pad. This effort will be in conjunction with other activities, and will include documentation of nest site fidelity before and after each launch. (Cuccarese, 2004; ENRI, 2002c, 2005)

Should any terrestrial mammals be present in the vicinity of the Complex during a launch, the animals might suffer startle responses and, if close enough to the launch pad, could be subject to TTS effects. However, these effects would be temporary and would not have a significant effect on local populations.

For a discussion on potential sonic boom impacts to marine mammals underwater, refer to Section 4.1.5.2.

<u>Launch Emissions.</u> The atmospheric deposition of launch emissions has the potential to acidify nearby surface waters. The types and quantities of emissions products released from MM-derived and PK-derived launch vehicles are listed in Tables 4-1 and 4-2, respectively. The principal combustion product of concern is hydrogen chloride gas, which forms hydrochloric acid when combined with water.

The acidification of surface waters in some of the streams and wetland areas close to the launch site could present harmful conditions for fish and other aquatic wildlife. Because of this concern, the AADC monitors the water quality of local streams. In support of each mission, pre- and post-launch water samples are taken from several stream sites within a few miles of the launch pad. A reference stream located well outside of the ROI is also sampled. In addition to pH and alkalinity, water quality analyses are conducted for perchlorate concentrations. The results have shown that prior launches have not had an effect on basic water chemistry. Perchlorate has not been detected in any water body tested near the Kodiak Launch Complex. Though sampling has identified low alkalinity levels and, therefore, low buffering capacity in these waters, stream testing following launches has not shown any decrease in pH levels (ENRI, 2002b, 2005). The constant deposition of windblown sea salt in the area helps to reduce the potential for surface water acidification. As a result, no adverse effects from OSP launches at Kodiak Launch Complex are expected.

<u>Launch Failure or Early Flight Termination.</u> In the unlikely event of a failure during launch, or an early termination of flight, the launch vehicle would most likely fall into the ocean reasonably intact, along with some scattered debris. Pieces of unburned solid propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be widely dispersed. Liquid propellants (e.g., hydrazine) contained in an orbital mission payload (spacecraft) and in the HAPS (if used) could also be released on impact, assuming they are not consumed or vaporized during the destruct. Small quantities of battery electrolyte could be released, as well.

Of particular concern is the ammonium perchlorate in solid propellants, and the toxicological aspects of the liquid propellants. However, as described in Section 4.1.1.3, the leaching of perchlorate from solid propellants has proven to be a slow process, and liquid propellants are quickly diluted in seawater, in addition to being buffered or oxidized.

The probability for an aborted OSP launch to occur is extremely low. If an early abort were to occur, actions would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the ground or in any of the nearby freshwater streams and wetland areas. Any recovery operations along the shoreline or in deeper coastal waters would be treated on a case-by-case basis. Any liquid or solid propellants remaining in the offshore waters would be subject to constant wave action and currents, thus eliminating the build-up of harmful concentrations. As a result, no significant impacts on wildlife would be expected.

Threatened and Endangered Species

The sights and sounds of rocket launches from Kodiak Launch Complex may affect Federally endangered Steller sea lions that haul out on the northern spit of Ugak Island, by causing them to move towards the water. However, these effects would be temporary and, as previously discussed, the sea lions do not breed on Ugak Island. Thus, the proposed launches are not likely to adversely affect the long-term well-being, reproduction rates, or survival of the species.

In 2001, the AADC submitted a request to the NOAA Fisheries Service for a LOA to take, by harassment, small numbers of marine mammals incidental to rocket launches from Kodiak Launch Complex. As a result of that request, the NOAA Fisheries Service is now proposing regulations that would authorize the incidental harassment of a small number of marine mammals during launches. That permit is anticipated to include some short term monitoring requirements designed to verify that launches from the Complex are having limited to no effects on the species. Until then, the AADC will continue with the interim Environmental Monitoring Plan in place since 1998. That plan calls for sound pressure monitoring at the northern spit of Ugak Island and at Narrow Cape, real time video recording of Steller sea lion behaviors on exposure to rocket motor noise, and pre- and post-aerial surveys of the Ugak Island spit to determine numbers present before and after launch. Monitoring would be conducted for launches that take place from June through October, the only time sea lions are likely to occupy the Ugak Island haul-outs. (69 FR 63114-63122; Cuccarese, 2004)

Regarding the recently designated Federally threatened northern sea otters occurring off Narrow Cape, only a few otters have been seen in the area and not on a regular basis (ENRI, 2002a, 2002c, 2005). Studies of southern sea otters (a close relative found at Vandenberg AFB) have not shown any evidence of mother-pup separation following rocket launches (SRS, 2001a). Thus, it is expected that launches from Kodiak Launch Complex would not have an adverse effect on the sea otters. However, in anticipation of the USFWS final ruling on designating threatened status for the northern sea otter, the AADC has already begun informal “conferencing” with the Service to determine whether any protective measures for the species will be necessary during launches. For each launch campaign, the AADC is also conducting aerial surveys to document any changes in sea otter numbers (Cuccarese, 2005).

As previously discussed, rocket launches from the Complex have not had a significant effect on bird habitat use patterns within the Narrow Cape area (ENRI, 2005). This would include both the Federally threatened Steller’s eider, an occasional visitor to the local offshore waters, and the endangered short-tailed albatross, which has not been sighted in the area during prior bird surveys. Though the AADC has, in prior years, conducted pre- and post-launch monitoring for Steller’s eider, the USFWS recently ended the formal agreement for surveys, based on previous monitoring data that showed no adverse effects on the species (Cuccarese, 2004).

Environmentally Sensitive and Critical Habitats

There are no designated critical habitat areas within the ROI that would be affected by launches from Kodiak Launch Complex.

As previously mentioned, rocket launch emissions would not impact the water quality of local surface waters. In case of a launch anomaly, actions would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the ground or in any of the nearby freshwater streams and wetland areas. Any recovery operations along the shoreline or in deeper coastal waters, however, would be treated on a case-by-case basis. As a result, no significant impacts to wetlands and EFH areas would occur.

4.1.2.3.3 Post-Launch Operations

The intermittent movement of trucks and any repair/clean-up/waste-handling equipment would not produce substantial levels of noise, and vehicles normally would remain on paved or gravel areas. Thus, the limited actions associated with post-launch operations would have no adverse effects on local vegetation or wildlife, including threatened and endangered species, and environmentally sensitive habitats.

4.1.2.4 Health and Safety

4.1.2.4.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

No facility modifications or construction are required for Kodiak Launch Complex. The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at the complex. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations within 29 CFR, would be followed, as well as all appropriate DOD and USAF regulations. The handling of large rocket motors, liquid propellants, and other vehicle ordnance is a hazardous operation that requires special care and training of personnel. By adhering to the established and proven safety standards and procedures identified in Section 3.2.4, the level of risk to workers and the general public would be minimal.

Whether the rocket motors and other ordnance are transported by road, rail, air, or water, the transportation systems used would provide environmental protection and physical security to the components. Heavily constructed trailers, carriages, and/or containers would be used to safely transport the motors. All transportation and handling requirements for the rocket motors and other ordnance would be accomplished in accordance with DOD, USAF, DOT, and applicable US Coast Guard policies and regulations to safeguard the materials from fire or other mishap. As described in Section 3.1.5, accident rates for ongoing operations involving rocket motor transportation have historically been very low.

Regarding any radioisotopes that might be used on spacecraft payloads, the amounts would be limited to small quantities, typically a few millicuries, and the materials would be encapsulated and installed onto the spacecraft prior to arrival at the range. Because of the small amount of material used and the safety precautions in place, the use of radiological materials in payloads would result in minimal health and safety risks.

Most spacecraft payloads would be equipped with radar, telemetry, and tracking system transmitters. To avoid potential non-ionizing radiation impacts, any ground tests of such systems prior to launch would comply with IEEE 95.1-1991 standards for limiting human exposure to radio frequency electromagnetic fields. Following launch and orbit insertion, such systems would present no radiation hazard to populated regions or to aircraft.

In addition, any spacecraft equipped with laser instruments must adhere to ANSI Z136.1-2000 and ANSI Z136.6-2000, as well as applicable Federal and state OSHA regulations regarding laser use. Should any ground tests of laser instruments be required prior to launch, only trained personnel would operate the laser systems, and personnel in close proximity to laser activities would wear appropriate personal protective equipment. In addition to eye and skin hazards, ANSI Z136.6-2000 also requires visible lasers, used outdoors, to cause no interference with other spacecraft and aircraft operations.

Consequently, no significant impacts to health and safety are expected.

4.1.2.4.2 Flight Activities

Adherence to the policies and procedures identified in Section 3.2.4 protects the health and safety of on-site personnel. The establishment of LHAs, impact debris corridors, and road closures, in addition to the NOTMARs and NOTAMs published for mariners and pilots, serves to protect the public health and safety. In support of each mission, a safety analysis would be conducted prior to launch activities to identify and evaluate potential hazards and reduce the associated risks to a level acceptable to the RSO. For each rocket launch from Kodiak Launch Complex, the allowable public risk limit for launch-related debris (from liftoff through to orbit insertion) is extremely low, as the following Range Safety Manual criteria show:

- Casualty expectation for all mission activities shall be less than 1 in 1,000,000 for individual risk, and less than 30 in 1,000,000 for collective risk;
- Probability of impacting a ship shall be less than 3 in 100,000;
- Probability of impacting an aircraft shall be less than 1 in 10,000,000 (AADC, 2003a).

Just as described in Section 4.1.1.5.2 for Vandenberg AFB, the risk of fatality to the public from OSP launches at Kodiak Launch Complex would be significantly less than the risk from accidents occurring in the home.

As a result, no significant impacts to health and safety are expected.

4.1.2.4.3 Post-Launch Operations

Post-launch refurbishment and blast residue removal are routine operations at Kodiak Launch Complex. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed. By adhering to the established safety standards and procedures identified in Section 3.2.4, the level of risk to workers and the general public would be minimal. Consequently, no significant impacts to health and safety are expected.

4.1.2.5 Hazardous Materials and Waste Management

4.1.2.5.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

No construction or facility modifications would be necessary for implementing OSP launches at Kodiak Launch Complex. The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at Kodiak Launch Complex. During pre-flight preparations, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.2.5. As an example, key elements in the management of liquid propellants for spacecraft would include material compatibility, security, leak detection and monitoring, spill control, personnel training, and specific spill-prevention mechanisms.

All hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable Federal, state, and local regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change.

4.1.2.5.2 Flight Activities

Flight activities normally would not utilize any hazardous materials or generate any hazardous waste. If an early abort were to occur at Kodiak Launch Complex, actions would immediately be taken for the recovery of unburned propellants and any other hazardous materials that had fallen on the ground or in any of the nearby freshwater streams and wetland areas. Any recovery operations along the shoreline and in deeper waters would be treated on a case-by-case basis. Any waste materials collected would be properly disposed of in accordance with applicable regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.2.5.3 Post-Launch Operations

The post-launch refurbishment and blast residue removal are routine activities at Kodiak Launch Complex that are conducted after every launch. The rain and artesian water that collects in the flame trench at Launch Pad 1 would also be periodically tested for water chemistry prior to discharge. The effects of the wastewater discharge would be monitored, as is currently done following other missions.

During this process, all hazardous materials and hazardous wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.2.5. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with applicable Federal, state, and local regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.3 CAPE CANAVERAL AIR FORCE STATION

4.1.3.1 Air Quality

4.1.3.1.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Construction requirements at LC-20 or LC-46, for example, would be minimal. Emissions from trucks and other equipment used during construction activities, rocket motor transport, and pre-launch support operations should have no measurable impact on regional air quality.

Similar to that described for Vandenberg AFB under Section 4.1.1.1, the loading of liquid propellants onto the HAPS and orbital spacecraft payloads may be required at either the Integration and Processing Facility, or the Spacecraft Processing Facility. However, because of operating procedures in place, and the use of closed loop fueling systems with air emission scrubbers, the amount of emissions from such operations at Cape Canaveral AFS would be very small. Based on prior air emission analyses for similar systems at the station, no significant impacts on air quality are expected during these fueling operations (NASA, 2002a)

4.1.3.1.2 Flight Activities

Launch activities for the OSP flights would have essentially the same impacts identified earlier in Section 4.1.1.1 for Vandenberg AFB, with the exception that only up to three (instead of four) MM-derived rocket launches per year would occur at the Cape Canaveral AFS. The total quantity of exhaust emissions for three MM-derived launches is shown in Table 4-5. Quantities of exhaust emissions for up to two PK-derived launches were provided earlier in Table 4-2. Only 1st-stage rocket emissions would normally occur within the ROI for Cape Canaveral AFS.

Table 4-5. Exhaust Emissions for Three Minuteman-Derived Launches

Emission	1st Stage (tons/year)	2nd Stage [1] (tons/year)	3rd Stage [2] (tons/year)	Total (tons/year)
Aluminum Oxide (Al_2O_3)	20.80	5.84	2.07	28.71
Carbon Monoxide (CO)	16.48	4.39	1.93	22.80
Carbon Dioxide (CO_2)	2.60	0.95	0.18	3.72
Chlorine (Cl)	0.08	0.03	0.00	0.11
Hydrogen Chloride (HCl)	14.86	4.63	0.20	19.70
Water (H_2O)	6.50	2.57	0.28	9.35
Hydrogen (H_2)	1.44	0.39	0.09	1.92
Nitrogen (N_2)	6.04	1.80	0.73	8.57
Other	0.02	0.01	0.00	0.03

Notes:

[1] Emissions are based on the SR19-AJ-1 motor.

[2] Emissions are based on the M57A-1 motor.

Source: SMC Det 12/RPD, 2005

During launches out over the ocean, rocket emissions from all stages would be rapidly dispersed and diluted over a large geographic area. Because the launches are short-term discrete events, the time between launches allows the dispersion of the emission products. The maximum total exhaust emissions would be less than that at Vandenberg AFB or Kodiak Launch Complex, because there would be one less MM-derived launch per year. The emissions per launch at Cape Canaveral AFS would be the same for each type of launch vehicle, but the atmospheric concentrations would differ depending on local meteorological conditions at the time of launch, such as temperature profiles, atmospheric stability, wind speeds, and the presence or absence of inversions. However, no violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

Because Brevard County is in full attainment with the NAAQS, no CAA Conformity Determination is required. OSP activities would not jeopardize the attainment status for the region.

4.1.3.1.3 Post-Launch Operations

Equipment repairs, cleaning of blast residues, and repainting (as necessary) would generate minimal emissions. As a result, little or no adverse effects on air quality are expected from post-launch activities.

4.1.3.2 Noise

4.1.3.2.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Noise levels generated during facility modifications at LC-20 or LC-46 are expected to be minimal and short term. The limited noise generated during pre-launch preparations comes primarily from the use of trucks and other load handling equipment, and is essentially confined to the immediate area surrounding the activities. Any noise exposure levels would comply with USAF Hearing Conservation Program requirements, as described in Section 3.1.2, and other applicable occupational health and safety requirements. The public in the nearby communities would not detect any increase in noise levels.

4.1.3.2.2 Flight Activities

Noise levels generated by each OSP mission would vary, depending on the launch site used, the launch vehicle configuration, launch trajectory, and weather conditions. Because PK-derived launches generate louder noise levels than MM-derived vehicles, because of higher thrust (SRS, 2002), PK and related Athena system launch noise data were used in this analysis to determine impact levels. Figure 4-4 depicts the predicted maximum noise-level contours for a proposed OSP launch from LC-20 and LC-46. The modeling results depicted in the figure represent a maximum predicted scenario that does not account for variations in weather or terrain. As shown in Figure 4-4, the ASEL generated can range from 100 dB and higher on Cape Canaveral AFS, to around 85 dB nearly 8 mi (13 km) away. For launches from LC-46, for example, the City of Cape Canaveral could experience a maximum ASEL close to 90 dB, while portions of the City of Cocoa Beach would experience nearly 85 dB ASEL. Launches from LC-20 would expose local communities to slightly lower levels of noise, but would result in higher noise levels occurring on the Kennedy Space Center.

While these noise exposure levels can be characterized as very loud in some areas, they would occur infrequently and are very short in duration (about 20 seconds of intense sound per launch). Any USAF personnel and contractors working near the area at time of launch are required to wear adequate hearing protection in accordance with USAF Hearing Conservation Program requirements. Noise levels experienced by the public would be well within the OSHA standard of 115 dBA over 15 minutes [29 CFR 1910.95(b)(2)] for permissible noise exposures.

Sonic booms generated by OSP launch vehicles would start reaching the surface some distance downrange of the launch site. These sonic booms generally occur well off the coast over ocean waters, and so are not an issue affecting coastal land areas. In addition, the sonic booms are typically audible for only a few milliseconds.

Based on this analysis, the action of conducting up to three MM-derived and two PK-derived launches per year from Cape Canaveral AFS would have no significant impact on ambient noise levels. The potential for launch noise and sonic boom impacts on protected wildlife species and sensitive habitats is discussed in Sections 4.1.3.3 and 4.1.5.2.

4.1.3.2.3 Post-Launch Operations

Because of the limited activities associated with post-launch operations, limited amounts of noise would be generated. Thus, no impacts to ambient noise levels are expected.

Source: Data depicted was extrapolated from Athena and Peacekeeper launch noise data, per ENRI, 2002a; and SRS, 1999, 2002

Figure 4-4. Predicted A-Weighted Sound Exposure Levels for OSP (Peacekeeper-Derived) Launches from Cape Canaveral AFS, Florida

4.1.3.3 Biological Resources

4.1.3.3.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

For the limited actions associated with facility modifications and pre-launch preparations on the Cape Canaveral AFS, the intermittent movement of trucks, construction equipment, and other load-handling equipment would not produce substantial levels of noise. These activities would be relatively short term, and vehicles and other equipment would normally remain on paved or gravel areas.

Thus, it is expected that these activities would have little or no adverse effects on local vegetation and wildlife, including threatened and endangered species, and critical and other environmentally sensitive habitats.

4.1.3.3.2 Flight Activities

Potential issues associated with OSP launch operations include wildlife responses and potential injury from excessive launch noise, and the release of potentially harmful chemicals in the form of exhaust emissions. The release of unburned propellant from a possible launch failure or termination is also considered. The potential effects of these actions on the biological resources at Cape Canaveral AFS are described in the paragraphs that follow.

Vegetation

Although heat and emissions from rocket exhaust can result in localized foliar scorching and spotting, such effects from larger launch systems have been shown to be temporary and not of sufficient intensity to cause long-term damage to vegetation (NASA, 2002a; USAF, 2000a). As previously mentioned, the vegetation immediately around launch pads is regularly mowed in order to minimize the risk of brush fires.

Wildlife

Launch Noise. Noise levels generated by proposed OSP launch vehicles would be similar to that of prior Athena systems launched from LC-46, but not as intense as Atlas and Delta systems launched from other nearby LCs. Based on the OSP mission noise predictions shown in Figure 4-4, all areas within approximately 3 mi (4.8 km) of the LC-20 or LC-46 launch sites would experience a minimum ASEL of 100 dB, while noise levels in the immediate vicinity of the launch pad could easily exceed 120 dB ASEL (SRS, 1999).

During launches at LC-20 or LC-46, it is possible that birds in the immediate area (including black skimmers, a Florida species of concern) would startle and flee the site for some period of time. However, monitoring of sea and shore birds during launches at Vandenberg AFB (see Section 4.1.1.3) has shown no interruption of activities, or any evidence of abnormal behavior or injury. The continued presence of sea and shore birds at the Cape demonstrates that rocket launches over the years have had little effect on these species.

As for other species in the LC-20 and LC-46 areas, any terrestrial mammals in close proximity to a launch might suffer startle responses. In addition, any mammal or reptile species (including gopher tortoises, a Florida Species of Concern) close enough to the launch pad could be subject to TTS effects. However, these effects would be temporary and would not have a significant effect on local populations. These findings are more evident when considering that OSP launches would represent brief events, occurring no more than five times per year at Cape Canaveral AFS. Prior launches from the Cape have not resulted in animal mortalities (USAF, 2001d).

For a discussion on potential sonic boom impacts to marine mammals and sea turtles underwater, refer to Section 4.1.5.2.

Launch Emissions. The atmospheric deposition of launch emissions has the potential to acidify nearby surface waters. The types and quantities of emissions products released from PK-derived and MM-derived launch vehicles are listed in Tables 4-2 and 4-4, respectively. The principal combustion product of concern is hydrogen chloride gas, which forms hydrochloric acid when combined with water.

The acidification of surface waters in some of the wetland areas close to the launch sites could present harmful conditions for aquatic wildlife. However, the areas of LC-20 and LC-46, being close to the ocean, are regularly subjected to wind-blown salt spray. The deposition of sea salt, in addition to carbonate minerals present in the soil and surface waters, would neutralize the acid from infrequent rocket emissions (USAF, 2000a, 2001d). As a result, little or no adverse effects from OSP launches at Cape Canaveral AFS are expected.

Launch Failure or Early Flight Termination. In the unlikely event of a failure during launch, or an early termination of flight, the launch vehicle would most likely fall into the ocean reasonably intact, along with some scattered debris. Pieces of unburned solid propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be widely dispersed. Liquid propellants (e.g., hydrazine) contained in an orbital mission payload (spacecraft) and in the HAPS (if used) could also be released on impact, assuming they are not consumed or vaporized during the destruct. Small quantities of battery electrolyte could be released, as well.

Of particular concern is the ammonium perchlorate in solid propellants, and the toxicological aspects of the liquid propellants. However, as described in Section 4.1.1.3, the leaching of perchlorate from solid propellants has proven to be a slow process, and liquid propellants are quickly diluted in seawater, in addition to being buffered or oxidized.

The probability for an aborted OSP launch to occur is extremely low. If an early abort were to occur, actions would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the beach within 6 ft (1.8 m) of water or in any of the nearby wetland areas. Any recovery from deeper coastal waters would be treated on a case-by-case basis. Any liquid or solid propellants remaining in the offshore waters would be subject to constant wave action and currents, thus eliminating the build-up of harmful concentrations. As a result, no significant impacts on wildlife would be expected.

Threatened and Endangered Species

Just as for other sea and shore birds, it is expected that proposed OSP launches from LC-20 or LC-46 would not have any lasting effects on least terns and piping plovers. Observations of scrub jays following Delta, Atlas, and Titan launches from Cape Canaveral AFS have shown normal behavior, indicating no noise-related effects (NASA, 2002a; USAF, 2001d).

As for other protected species in the LC-20 and LC-46 areas, the Southeastern beach mouse, American alligator, and the Eastern indigo snake could be startled during a launch, and might experience some levels of TTS if close enough to a launch, but no lasting ill effects are expected. Per earlier discussions, prior launches from the Cape have not resulted in animal mortalities (USAF, 2001d).

In general, launch operations from either launch site are not likely to have any effects on sea turtles or sea turtle nests along the beaches. Artificial light from launch facilities, however, could disorient sea turtles and hatchlings at night, causing them to move in the wrong direction, away from the ocean water. To prevent such occurrences, existing Light Management Plans (LMPs) would need to be modified to address any new lighting configurations. Further discussions on this issue are provided later under "Environmentally Sensitive and Critical Habitats."

For launches from LC-20, surface areas over the Banana River, where Florida manatees occur, could be subjected to launch noise levels up to approximately 105 dB ASEL (see Figure 4-4). Because LC-46 is further from the river, noise levels from this site would be substantially lower. Though the hearing sensitivity of manatees has not been well studied, manatees have shown to be relatively unresponsive to anthropogenic noise (USAF, 1998). Since manatees spend most of the time submerged, and since they do not startle readily, launch noise from LC-20 or LC-46 is not expected to affect the animals.

Overall, the proposed OSP launches are not likely to adversely affect the long-term well-being, reproduction rates, or survival of any of these threatened or endangered species.

Environmentally Sensitive and Critical Habitats

There are no designated critical habitat areas within the ROI on Cape Canaveral AFS that would be affected by proposed OSP launches.

OSP-related launch operations are not expected to disturb scrub jay habitat areas adjacent to the launch sites. Because of vegetation management around the launch sites, the risk of brush fires from launches is minimal.

Sea turtle nesting habitat along the Station beaches would not be affected by OSP facility operations. However, to prevent facility lighting from potentially affecting the behavior and movement of adult sea turtles and hatchlings at night, the existing LMP for LC-20 or LC-46 would need to be modified for proposed OSP activities in accordance with 45th SWI 32-7001. This would include site preparations and launch operations, and any additional lighting that might be needed. Once specific OSP activities and lighting requirements are identified, consultations with the USFWS would be reinitiated to amend the LMP and for approval. LMP modifications might include use of low-pressure sodium light fixtures, shielding of lights, and special light management steps where lights are visible from the beach.

The Merritt Island National Wildlife Refuge located just north and west of the Station would be subjected to launch noise, particularly from the LC-20 launch site (see Figure 4-4). Launch noise levels from LC-20 could reach 95 dB ASEL over Refuge areas on Kennedy Space Center, and reach approximately 105 dB ASEL over portions of the Banana River, which includes critical habitat for the Florida manatee. Such brief noise levels, however, are not expected to cause behavioral changes in the wildlife found in these areas, or adversely affect the manatee's critical habitat.

Per earlier discussions, rocket launch emissions would not impact the water quality of local surface waters. If a launch anomaly were to occur, actions at Cape Canaveral AFS would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the ground or in any of the wetlands and shoreline areas. Any recovery operations in deeper coastal waters, however, would be treated on a case-by-case basis. As a result, no significant impacts to wetlands or EFH areas would occur.

4.1.3.3.3 Post-Launch Operations

The intermittent movement of trucks and any repair/clean-up/waste-handling equipment would not produce substantial levels of noise, and vehicles normally would remain on paved or gravel areas. Thus, the limited actions associated with post-launch operations would have no adverse effects on local vegetation or wildlife, including threatened and endangered species, and critical and other environmentally sensitive habitats.

4.1.3.4 Health and Safety

4.1.3.4.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Though site modifications proposed at LC-20 or LC-46 would be minimal, all workers, including both military personnel and contractors, would be required to comply with applicable AFOSH and OSHA regulations and standards.

The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at the station. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations within 29 CFR, would be followed, as well as all appropriate DOD and USAF regulations. The handling of large rocket motors, liquid propellants, and other vehicle ordnance is a hazardous operation that requires special care and training of personnel. By adhering to the established and proven safety standards and procedures identified in Section 3.3.4, the level of risk to military personnel, contractors, and the general public would be minimal.

Whether the rocket motors and other ordnance are transported by road, rail, or air, the transportation systems used would provide environmental protection and physical security to the components. Heavily constructed trailers, carriages, and/or containers would be used to safely transport the motors. All transportation and handling requirements for the rocket motors and other ordnance would be accomplished in accordance with DOD, USAF, and DOT policies and regulations to safeguard the materials from fire or other mishap. As described in Section 3.1.5, accident rates for ongoing operations involving rocket motor transportation have historically been very low.

Regarding any radioisotopes that might be used on spacecraft payloads, the amounts would be limited to small quantities, typically a few millicuries, and the materials would be encapsulated and installed onto the spacecraft prior to arrival at the range. Because of the small amount of material used and the safety precautions in place, the use of radiological materials in payloads would result in minimal health and safety risks.

Most spacecraft payloads would be equipped with radar, telemetry, and tracking system transmitters. To avoid potential non-ionizing radiation impacts, any ground tests of such systems prior to launch would comply with IEEE 95.1-1991 standards and applicable USAF standards for limiting human exposure to radio frequency electromagnetic fields. Following launch and orbit insertion, such systems would present no radiation hazard to populated regions or to aircraft.

In addition, any spacecraft equipped with laser instruments must adhere to ANSI Z136.1-2000 and ANSI Z136.6-2000, as well as applicable Federal and state OSHA regulations regarding laser use. Should any ground tests of laser instruments be required prior to launch, only trained personnel would operate the laser systems, and personnel in close proximity to laser activities would wear appropriate personal protective equipment. In addition to eye and skin hazards, ANSI Z136.6-2000 also requires visible lasers, used outdoors, to cause no interference with other spacecraft and aircraft operations.

Consequently, no significant impacts to health and safety are expected.

4.1.3.4.2 Flight Activities

Adherence to the policies and procedures identified in Section 3.3.4 protects the health and safety of on-site personnel. The establishment of LHAs and impact debris corridors, in addition to the NOTMARs and NOTAMs published for mariners and pilots, serves to protect the public health and safety. In support of each mission, a safety analysis would be conducted prior to launch activities to identify and evaluate potential hazards and reduce the associated risks to a level acceptable to Range Safety. For each rocket launch from the Eastern Range, the allowable public risk limit for launch-related debris (from liftoff through to orbit insertion) is extremely low, as the following AFSPCMAN 91-710 and RCC 321-02 Supplement criteria show:

- Casualty expectation for all mission activities shall be less than 1 in 1,000,000 for individual risk, and less than 30 in 1,000,000 for collective risk;

- Probability of impacting a ship shall be less than 1 in 100,000;

- Probability of impacting an aircraft shall be less than 1 in 1,000,000 (AFSPC, 2004; RCC, 2002).

Just as described in Section 4.1.1.5.2 for Vandenberg AFB, the risk of fatality to the public from OSP launches at Cape Canaveral AFS would be significantly less than the risk from accidents occurring in the home.

As a result, no significant impacts to health and safety are expected.

4.1.3.4.3 Post-Launch Operations

Post-launch refurbishment and blast residue removal are routine operations at Cape Canaveral AFS. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate DOD and USAF regulations. By adhering to the established safety standards and procedures identified in Section 3.3.4, the level of risk to military personnel, contractors, and the general public would be minimal. Consequently, no significant impacts to health and safety are expected.

4.1.3.5 Hazardous Materials and Waste Management

4.1.3.5.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Site modifications proposed for LC-20 and/or LC-46 would not disturb existing IRP sites and ongoing monitoring activities. Modifications to some of the existing facilities, however, might require lead-based paint and asbestos surveys if such information is not already available. Additionally for LC-20, coatings on the launch stand and the exterior of nearby facilities may require sampling for any remaining PCBs. Any removal of hazardous materials from the facilities would require containerizing and proper disposal at permitted facilities.

The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at Cape Canaveral AFS. During pre-flight preparations, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.3.5. As an example, key elements in the management of liquid propellants for spacecraft would include material compatibility, security, leak detection and monitoring, spill control, personnel training, and specific spill-prevention mechanisms.

All hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable Federal, state, local, DOD, and USAF regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change.

4.1.3.5.2 Flight Activities

Flight activities normally would not utilize any hazardous materials or generate any hazardous waste. If an early launch abort were to occur, base actions would immediately be taken for the recovery of unburned propellants (solid or liquid) and any other hazardous materials that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby wetland areas. Any recovery from deeper coastal waters would be treated on a case-by-case basis. Any waste materials collected would be properly disposed of in accordance with applicable regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.3.5.3 Post-Launch Operations

The post-launch refurbishment and blast residue removal are all routine activities at Cape Canaveral AFS. During this process, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.3.5. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with applicable Federal, state, local, DOD, and USAF regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.4 WALLOPS FLIGHT FACILITY

4.1.4.1 Air Quality

4.1.4.1.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Construction activities at Launch Pad 0-A, if used, are expected to be minimal. No construction would be necessary for Launch Pad 0-B. Emissions from trucks and other equipment used during construction activities, rocket motor transport, and pre-launch support operations should have no measurable impact on regional air quality.

Similar to that described for Vandenberg AFB under Section 4.1.1.1, the loading of liquid propellants onto the HAPS and orbital spacecraft payloads may be required at Building Y-15 on Wallops Island. However, because of operating procedures in place, and the use of closed-loop fueling systems with air emission scrubbers, the amount of emissions from such operations at Wallops Flight Facility would be very small. Based on prior air emission analyses for similar systems, no significant impacts on air quality are expected during these fueling operations (NASA, 2002a).

4.1.4.1.2 Flight Activities

Launch activities for the OSP flights would have essentially the same impacts identified earlier in Section 4.1.1.1 for Vandenberg AFB, with the exception that only up to three, rather than four, MM-derived rocket launches per year would occur at Wallops Flight Facility. The total quantity of exhaust emissions for two PK-derived launches is shown in Table 4-2. Quantities of exhaust emissions for up to three MM-derived launches are provided in Table 4-5. Only 1st-stage rocket emissions would normally occur within the ROI for Wallops Flight Facility.

During launches out over the ocean, rocket emissions from all stages would be rapidly dispersed and diluted over a large geographic area. Because the launches are short-term discrete events, the time between launches allows the dispersion of the emission products. The maximum total exhaust emissions would be less than that at Vandenberg AFB or Kodiak Launch Complex, because there would be one less

MM-derived launch per year. The emissions per launch at Wallops Flight Facility would be the same for each type of launch vehicle, but the atmospheric concentrations would differ depending on local meteorological conditions at the time of launch, such as temperature profiles, atmospheric stability, wind speeds, and the presence or absence of inversions. However, no violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

Because Accomack County is in full attainment with the NAAQS, no CAA Conformity Determination is required. OSP activities would not jeopardize the attainment status for the region.

4.1.4.1.3 Post-Launch Operations

Equipment repairs, cleaning of blast residues, and repainting (as necessary) would generate minimal emissions. As a result, little or no adverse effects on air quality are expected from post-launch activities.

4.1.4.2 Noise

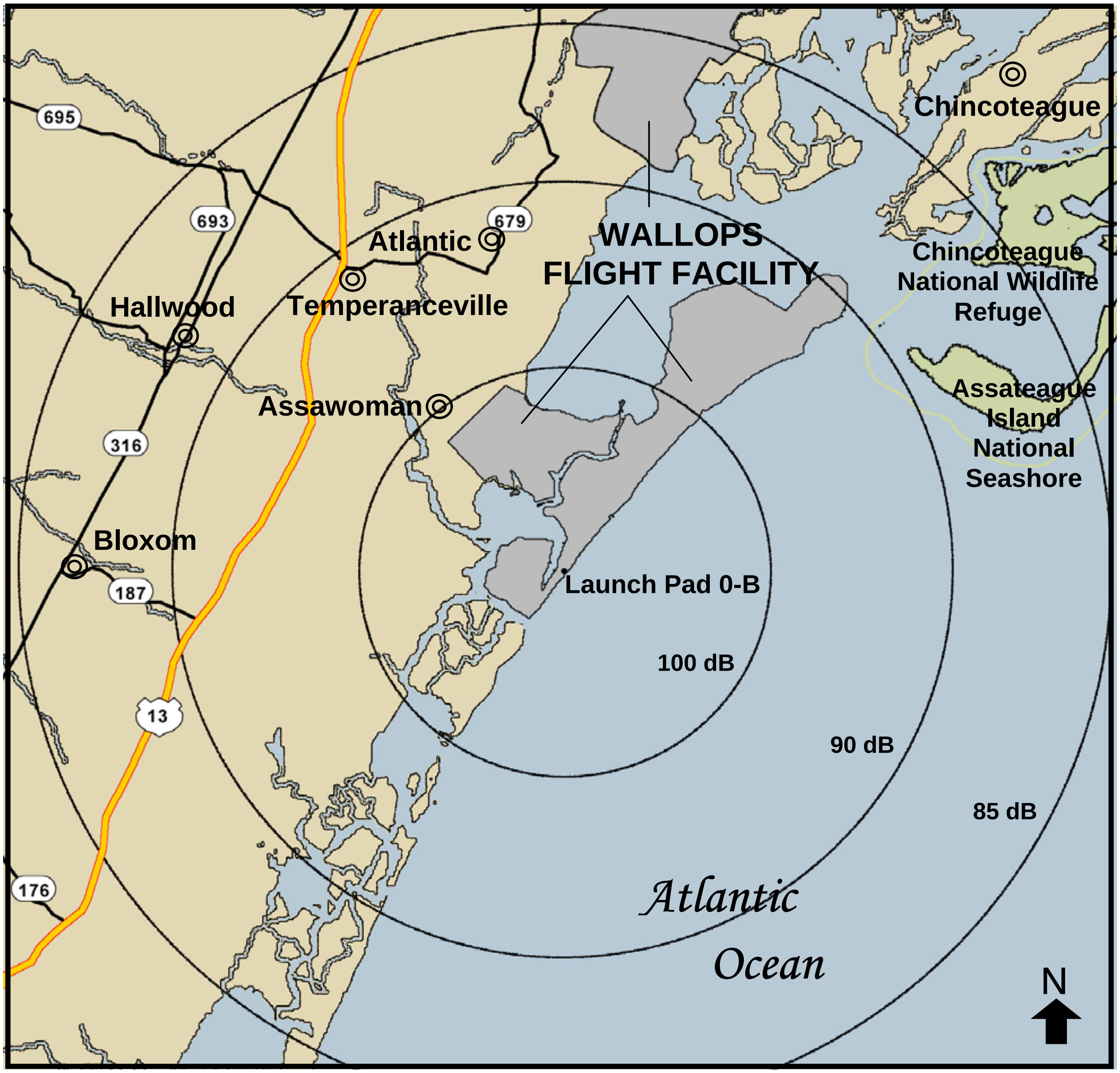
4.1.4.2.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Noise exposures during modification and construction activities at Launch Pad 0-A are expected to be minimal and short term. The limited noise generated during pre-launch preparations comes primarily from the use of trucks and other load handling equipment, and is essentially confined to the immediate area surrounding the activities. Any noise exposure levels would comply with OSHA regulatory requirements. With the exception of some brief periods of increased truck traffic on local roads, the public in nearby communities would not detect any increase in noise levels.

4.1.4.2.2 Flight Activities

Noise levels generated by each OSP mission would vary, depending on the launch vehicle configuration, launch trajectory, and weather conditions. Because PK-derived launches generate louder noise levels than MM-derived vehicles, because of higher thrust (SRS, 2002), PK and related Athena system launch noise data were used in this analysis to determine impact levels. Figure 4-5 depicts the predicted maximum noise-level contours for a proposed OSP launch from Launch Pad 0-B. Because of the close proximity of Launch Pads 0-A and 0-B along the shoreline—a distance of approximately 1,280 ft (390 m) separates the two pads—there would be little difference in area noise levels from either launch site. The modeling results depicted in the figure represents a maximum predicted scenario that does not account for variations in weather or terrain. As shown in Figure 4-5, the ASEL generated can range from 100 dB and higher within approximately 3 mi (4.8 km) of the launch site, to around 85 dB nearly 8 mi (13 km) away. The towns of Atlantic and Temperanceville, for example, would be subject to ASELs of between 87 and 93 dB. Some closer residents, including the Town of Assawoman, could experience noise levels of around 100 dB ASEL.

While these noise exposure levels can be characterized as very loud in some areas, they would occur infrequently and are very short in duration (about 20 seconds of intense sound per launch). Any Wallops Flight Facility workers subject to excessive launch noise would be required to wear adequate hearing protection in accordance with OSHA regulations. Outside the facility, noise levels experienced by the public would be well within the OSHA standard of 115 dBA over 15 minutes [29 CFR 1910.95(b)(2)] for permissible noise exposures. For comparison, a passing freight train at less than 50 ft (15 m), or an ambulance siren at less than 100 ft (30 m), would produce similar sound exposure levels. Handheld circular saws and leaf blowers, for example, can produce noise levels in excess of 100 dBA. To help minimize launch noise-related concerns in the local community, the public would be notified in advance of launch dates.



Source: Data depicted was extrapolated from Athena and Peacekeeper launch noise data, per ENRI, 2002a; and SRS, 1999, 2002

Figure 4-5. Predicted A-Weighted Sound Exposure Levels for OSP (Peacekeeper-Derived) Launches from Wallops Flight Facility (Wallops Island), Virginia

Sonic booms generated by OSP launch vehicles would start reaching the surface some distance downrange of the launch site. These sonic booms would generally occur well off the coast over ocean waters. Because NASA permits sonic booms to occur only over the ocean, populated areas along the Maryland or Virginia coastlines would not be affected by the resulting overpressures. In addition, the sonic booms would occur infrequently and would be audible for only a few milliseconds.

Based on this analysis, the action of conducting up to three MM-derived and two PK-derived launches per year from Wallops Flight Facility would have no significant impact on ambient noise levels. The potential for launch noise and sonic boom impacts on protected wildlife species and sensitive habitats is discussed in Sections 4.1.4.3 and 4.1.5.2.

4.1.4.2.3 Post-Launch Operations

Because of the limited activities associated with post-launch operations, limited amounts of noise would be generated. Thus, no impacts to ambient noise levels are expected.

4.1.4.3 Biological Resources

4.1.4.3.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

For the limited actions associated with construction and pre-launch preparations on Wallops Flight Facility, the intermittent movement of trucks, construction equipment, and other load-handling equipment would not produce substantial levels of noise. These activities would be relatively short term, and vehicles and other equipment would normally remain on paved or gravel areas.

Thus, it is expected that these activities would have little or no adverse effects on local vegetation and wildlife, including threatened and endangered species, and critical and other environmentally sensitive habitats.

4.1.4.3.2 Flight Activities

Potential issues associated with OSP launch operations include wildlife responses and potential injury from excessive launch noise, and the release of potentially harmful chemicals in the form of exhaust emissions. The release of unburned propellant from a possible launch failure or termination is also considered. The potential effects of these actions on the biological resources at Wallops Flight Facility and on neighboring islands are described in the paragraphs that follow.

Vegetation

During a launch, the exhaust heat and atmospheric deposition of emissions has the potential to harm nearby vegetation. Although localized foliar scorching and spotting is possible, such effects from larger launch systems have been shown to be temporary and not of sufficient intensity to cause long-term damage to vegetation (NASA, 2002a; USAF, 2000a). As previously mentioned, the vegetation immediately around the launch pads is managed in order to minimize the risk of brush fires.

Wildlife

Launch Noise. Based on the OSP mission noise predictions shown in Figure 4-5, all areas within approximately 3 mi (4.8 km) of the launch site would experience a minimum ASEL of 100 dB, while noise levels in close proximity to the launch pad could easily exceed 120 dB ASEL (SRS, 1999). It is possible that birds in the immediate area of a launch would startle and flee the site for some period of time. However, the monitoring of sea and shore birds during similar launches at Vandenberg AFB (see Section 4.1.1.3) has shown no interruption of activities, or any evidence of abnormal behavior or injury. On Wallops Island, the continued presence and breeding of sea and shore birds demonstrates that rocket launches over the years have had little effect on these species.

Any terrestrial mammals in close proximity to a launch on Wallops Island might suffer startle responses and, if close enough to the launch pad, could be subject to TTS effects. However, these effects would be temporary and would not have a significant effect on local populations. Amphibian and reptile species in the immediate area of a launch might also suffer startle responses, but no long-term impacts are expected. These findings are more evident when considering that OSP launches would represent brief events, occurring no more than five times per year at Wallops Island.

For a discussion on potential sonic boom impacts to marine mammals and sea turtles underwater, refer to Section 4.1.5.2.

Launch Emissions. The atmospheric deposition of launch emissions has the potential to acidify nearby surface waters. The types and quantities of emissions products released from PK-derived and MM-derived launch vehicles are listed in Tables 4-2 and 4-4, respectively. The principal combustion product of concern is hydrogen chloride gas, which forms hydrochloric acid when combined with water.

The acidification of surface waters in some of the tidal marsh wetlands and guts close to the launch sites could present harmful conditions for aquatic wildlife. However, these estuarine waters would have sufficient buffering capacity to neutralize the acid from infrequent rocket emissions. As a result, little or no adverse effects from OSP launches at Wallops Flight Facility are expected.

Launch Failure or Early Flight Termination. In the unlikely event of a failure during launch, or an early termination of flight, the launch vehicle would most likely fall into the ocean reasonably intact, along with some scattered debris. Pieces of unburned solid propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be widely dispersed. Liquid propellants (e.g., hydrazine) contained in an orbital mission payload (spacecraft) and in the HAPS (if used) could also be released on impact, assuming they are not consumed or vaporized during the destruct. Small quantities of battery electrolyte could be released, as well.

Of particular concern is the ammonium perchlorate in solid propellants, and the toxicological aspects of the liquid propellants. However, as described in Section 4.1.1.3, the leaching of perchlorate from solid propellants has proven to be a slow process, and liquid propellants are quickly diluted in seawater, in addition to being buffered or oxidized.

The probability for an aborted OSP launch to occur is extremely low. If an early abort were to occur, actions would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the beach within 6 ft (1.8 m) of water or in any of the nearby marshlands or guts. Any recovery from deeper coastal waters would be treated on a case-by-case basis. Any liquid or solid propellants remaining in the offshore waters would be subject to constant wave action and currents, thus eliminating the build-up of harmful concentrations. As a result, no significant impacts on wildlife would be expected.

Threatened and Endangered Species

The sights and sounds of OSP launches at Wallops Island could affect threatened and endangered piping plovers, Wilson's plovers, gull-billed terns, and upland sandpipers by causing them to temporarily abandon nearby areas during migration and/or the breeding season. However, just as for other sea and shore birds found at Wallops Island, the proposed OSP launches (up to five per year) are expected to have little or no impact on the listed species. For piping plovers, in particular, the USFWS anticipates minimal impacts from such launches and no incidental takes because: (1) the short duration of the disturbance, (2) the distance between the launch pad and the nearest plover nesting/foraging area, (3) the limited number of launches that would likely occur during the nesting season, and (4) the lack of other disturbances in the area (e.g., recreational activities) (NASA, 2005; USFWS, 1997). Thus, the proposed launches are not expected to have an adverse effect on the long-term well-being, reproduction rates, or survival of the species.

Though an incidental take of any piping plovers would not be expected to occur, NASA has developed a monitoring plan to better understand the effects of rocket launches on piping plover behavior. Developed in 1997 through consultations with the USFWS, the plan calls for the biological monitoring of piping plovers on the south end of Wallops Island during the first three launches from launch pad 0-B occurring between March 1 and September 15. Both pre- and post-launch monitoring would be conducted, as well as monitoring during launch if it can be conducted safely. Depending on the results of the surveys, and at the discretion of the USFWS, additional years of monitoring might be required, and NASA and the USFWS could make new determinations on impacts. (NASA, 2005; USFWS, 1997)

Regarding the peregrine falcon nest on the northwest side of Wallops Island, the nest site is located a few miles from the launch pads (0-A and 0-B) and, thus, would be subject to much lower and less disturbing noise levels. Because peregrine falcons, and bald eagles, are seen only occasionally near the south end of the island, and because OSP launches would occur infrequently, it is expected that no adverse effects would occur to these species. To help ensure the local presence of these species, Wallops Flight Facility has implemented a policy to avoid areas known to contain nesting peregrine falcons and bald eagles (NASA, 2005).

Environmentally Sensitive and Critical Habitats

The closest piping plover critical habitat to the 0-A and 0-B launch pads is approximately 4,000 ft (1,219 m) to the southeast (see Figure 3-6). At this distance, the habitat area would be subject to brief launch noise levels as high as 115 dB ASEL, but otherwise would not be adversely affected by launch operations. To help protect the plover population, the critical habitat areas on Wallops Island are closed to vehicle and human traffic during the nesting season, from March 15 through September 15. Additionally, helicopters and other aircraft must adhere to a 1,000-ft (305-m) no-fly zone horizontally and vertically from the plover habitat areas during the nesting season. (NASA, 1999, 2005)

As for possible launch noise impacts on the Chincoteague National Wildlife Refuge, noise levels are not expected to exceed approximately 85 dB ASEL and only on the southwestern end of the refuge (see Figure 4-5). On Assateague Island National Seashore, the ASEL at the southern end of the island could near 90 dB. Such moderate and brief noise levels are not expected to cause any behavioral changes in the wildlife found in these areas, including the population of Chincoteague ponies that reside on Assateague Island.

Per earlier discussions, rocket launch emissions would not impact the water quality of local surface waters. If a launch anomaly were to occur, actions at Wallops Flight Facility would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the ground or in any of the nearby estuaries, embayments, and shoreline areas. Any recovery operations in deeper coastal waters, however, would be treated on a case-by-case basis. As a result, no significant impacts to EFH areas would occur.

4.1.4.3.3 Post-Launch Operations

The intermittent movement of trucks and any repair/clean-up/waste-handling equipment would not produce substantial levels of noise, and vehicles normally would remain on paved or gravel areas. Thus, the limited actions associated with post-launch operations would have no adverse effects on local vegetation or wildlife, including threatened and endangered species, and critical and other environmentally sensitive habitats.

4.1.4.4 Health and Safety

4.1.4.4.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Construction requirements at the Wallops Flight Facility are expected to be minimal. The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at the facility. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations within 29 CFR, would be followed, as well as all appropriate NASA regulations. The handling of large rocket motors, liquid propellants, and other vehicle ordnance is a hazardous operation that requires special care and training of personnel. By adhering to the established and proven safety standards and procedures identified in Section 3.4.4, the level of risk to workers and the general public would be minimal.

Whether the rocket motors and other ordnance are transported by road, rail, or air, the transportation systems used would provide environmental protection and physical security to the components. Heavily constructed trailers, carriages, and/or containers would be used to safely transport the motors. All transportation and handling requirements for the rocket motors and other ordnance would be accomplished in accordance with DOD, USAF, and DOT policies and regulations to safeguard the materials from fire or other mishap. As described in Section 3.1.5, accident rates for ongoing operations involving rocket motor transportation have historically been very low.

Regarding any radioisotopes that might be used on spacecraft payloads, the amounts would be limited to small quantities, typically a few millicuries, and the materials would be encapsulated and installed onto the spacecraft prior to arrival at the range. Because of the small amount of material used and the safety precautions in place, the use of radiological materials in payloads would result in minimal health and safety risks.

Most spacecraft payloads would be equipped with radar, telemetry, and tracking system transmitters. To avoid potential non-ionizing radiation impacts, any ground tests of such systems prior to launch would comply with IEEE 95.1-1991 standards for limiting human exposure to radio frequency electromagnetic fields. Following launch and orbit insertion, such systems would present no radiation hazard to populated regions or to aircraft.

In addition, any spacecraft equipped with laser instruments must adhere to ANSI Z136.1-2000 and ANSI Z136.6-2000, as well as applicable Federal and state OSHA regulations regarding laser use. Should any ground tests of laser instruments be required prior to launch, only trained personnel would operate the laser systems, and personnel in close proximity to laser activities would wear appropriate personal protective equipment. In addition to eye and skin hazards, ANSI Z136.6-2000 also requires visible lasers, used outdoors, to cause no interference with other spacecraft and aircraft operations.

Consequently, no significant impacts to health and safety are expected.

4.1.4.4.2 Flight Activities

Adherence to the policies and procedures identified in Section 3.4.4 protects the health and safety of on-site personnel. The establishment of LHAs and impact debris corridors, in addition to the NOTMARs and NOTAMs published for mariners and pilots, serves to protect the public health and safety. A safety analysis would be conducted prior to launch activities to identify and evaluate potential hazards and reduce the associated risks to a level acceptable to the RSO. For each rocket launch from Wallops Flight

Facility, the allowable public risk limit for launch-related debris (from liftoff through to orbit insertion) is extremely low, as the following Range Safety Manual criteria show:

- Casualty expectation for all mission activities shall be less than 1 in 1,000,000 for collective risk (individual risk may be lower);
- Probability of impacting a ship shall be less than 1 in 100,000;
- Probability of impacting an aircraft shall be less than 1 in 10,000,000 (NASA, 2002b).

Just as described in Section 4.1.1.5.2 for Vandenberg AFB, the risk of fatality to the public from OSP launches at Wallops Flight Facility would be significantly less than the risk from accidents occurring in the home.

As a result, no significant impacts to health and safety are expected.

4.1.4.4.3 Post-Launch Operations

Post-launch refurbishment and blast residue removal are routine operations at Wallops Flight Facility. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate NASA regulations. By adhering to the established safety standards and procedures identified in Section 3.4.4, the level of risk to workers and the general public would be minimal. Consequently, no significant impacts to health and safety are expected.

4.1.4.5 Hazardous Materials and Waste Management

4.1.4.5.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

The booster inspections, vehicle integration, and fueling of payloads during pre-launch operations are all routine activities at Wallops Flight Facility. During pre-flight preparations, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.4.5. As an example, key elements in the management of liquid propellants for spacecraft would include material compatibility, security, leak detection and monitoring, spill control, personnel training, and specific spill-prevention mechanisms.

All hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable Federal, state, local, and NASA regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change.

4.1.4.5.2 Flight Activities

Flight activities normally would not utilize any hazardous materials or generate any hazardous waste. If an early launch abort were to occur, base actions would immediately be taken for the recovery of unburned propellants (solid or liquid) and any other hazardous materials that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby wetland areas. Any recovery from deeper coastal waters would be treated on a case-by-case basis. Any waste materials collected would be properly disposed of in accordance with applicable regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.4.5.3 Post-Launch Operations

The post-launch refurbishment and blast residue removal are all routine activities at Wallops Flight Facility. During this process, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.4.5. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with applicable Federal, state, local, and NASA regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.5 GLOBAL ENVIRONMENT

4.1.5.1 Upper Atmosphere/Stratospheric Ozone Layer

The exhaust emissions from the solid propellant rocket motors contain chlorine compounds, produced primarily as hydrogen chloride at the nozzle. Through high temperature "afterburning" reactions in the exhaust plume, the hydrogen chloride is partially converted to atomic chlorine. These more active forms of chlorine can contribute to localized ozone depletion in the wake of the launch vehicle and to overall global chlorine loading, which contributes to long-term ozone depletion. Studies have shown that the hydrogen chloride remains in the stratosphere for about 3 years and then diffuses down to the troposphere. (Brady, 2002; USAF, 2001b)

Because of the large air volume over which these emissions are spread, and because of rapid dispersion by stratospheric winds, the active chlorine from the OSP launches should not contribute to localized depletion of the ozone layer at any of the four proposed launch sites. On a global scale, this represents a very small fraction of chlorine released. Therefore, any adverse effects would likely be insignificant.

Two other types of substances, Al_2O_3 and NO_x species, also are of concern with respect to stratospheric ozone depletion. The Al_2O_3, which is emitted as solid particles, has been the subject of study with respect to ozone depletion via reactions on solid surfaces. The studies indicate that Al_2O_3 can activate chlorine. The exact magnitude of ozone depletion that can result from a buildup of Al_2O_3 over time has not yet been determined quantitatively, but is considered insignificant based on existing analyses. (USAF, 2001b)

Nitrogen oxide, like certain chlorine-containing compounds, contributes to catalytic gas phase ozone depletion. The production of NO_x species from solid rocket motors is dominated by high-temperature "afterburning" reactions in the exhaust plume. As the temperature of the exhaust decreases with increasing altitude, less NO_x is formed (Brady, 2002). Again, on a global scale, this represents a very small fraction of NO_x species generated and, thus would not have a significant effect on ozone levels.

In addition to the rocket propellant emissions, the MM 2nd-stage thrust vector control would release with each launch most of the 260 lb (118 kg) of Halon 2402 gas carried on board. Although Halon 2402 is a Class I ozone depleting substance, the amount of gas to be released, from up to four launches per year [0.52 tons (0.47 metric tons)], is insignificantly small compared to the amount of all human-produced Class I substances released from the United States annually [in excess of 52,785 tons (47,900 metric tons) in 2001] (USEPA, 2003a).

In summary, the quantity of hydrogen chloride, Al_2O_3, NO_x, and Halon gas emissions released into the stratosphere from up to four MM-derived and two PK-derived launches per year would be relatively small compared to emissions released on a global scale. Thus, these substances should not have a significant impact on stratospheric ozone.

4.1.5.2 Broad Ocean Area/Marine Life

Proposed OSP launches would not have a discernible or measurable impact on benthic or planktonic organisms, because of their abundance, their wide distribution, and the protective influence of the mass of the ocean around them. However, the potential exists for impacts to larger vertebrates in the nekton, particularly those that must come to the surface to breathe (e.g., marine mammals and sea turtles). Potential impacts on these protected species have been considered in this analysis and include the effects of acoustic stimuli produced by launches (sonic booms), and non-acoustic effects (splash-down of launch vehicle stages and sub-orbital payloads, and release of propellants or other contaminants into the water). Potential acoustic effects include behavioral disturbance (including displacement), acoustic masking resulting from launch noise, and temporary or permanent hearing impairment. Potential non-acoustic effects include physical impact by falling debris, and contact with or ingestion of debris or hazardous materials, particularly unexpended fuels. The resulting impact of a large, fast-moving object, such as the spent casing of a rocket motor, could cause either type of effect. These issues are further discussed in the following sections.

4.1.5.2.1 Sonic Boom Overpressures

A recent noise study of MM ICBM test launches from Vandenberg AFB modeled the sonic boom levels generated downrange (Tooley, et al., 2004). The modeling results show that sonic boom overpressures at the ocean surface are typically near their maximum level at a distance of about 25 nautical miles (46 km) off the coast. The surface footprint of the sonic boom can extend outward several miles on each side of the flight path, but it quickly dissipates with increasing distance downrange. At the ocean surface, peak overpressures were estimated to be in the 138 to 149 dB (referenced to 20 μPa)] range in air, based on typical atmospheric wind conditions. The duration of these overpressures is less than 250 milliseconds.

Another study has shown RV simulators—used on the same sub-orbital ICBM tests—to also produce sonic booms on their descent to the ocean surface at the terminal end of each flight (Moody, 2004b). Generated several thousand miles downrange, the sonic booms initially occur over a very broad area of the ocean and continue towards the point of impact, where the sonic boom footprint narrows to just a few miles on either side of the flight path. Moving at hypersonic velocities, the RV simulators generate sonic booms ranging from 91 dB to 150 dB (referenced to 20 μPa) near the point of impact. The duration for sonic boom overpressures produced by the RVs ranges from 40 milliseconds where the boom is strongest to 124 milliseconds where it is weakest.

The sonic booms produced by the MM ICBM flight tests are representative of those expected from the OSP launch vehicles. For some OSP sub-orbital flights, this includes the sonic booms from target payloads, which would be similar to the sonic booms generated by ICBM RV simulators.

The propagation of sonic booms underwater could affect the behavior and hearing sensitivity in marine mammals (primarily cetaceans), sea turtles, and other fauna. If the sounds were to be strong enough, they might cause animals to quickly react, altering (briefly) their normal behavior. Such behavioral reactions might include cessation of resting, feeding, or social interactions; changes in surfacing, respiration, or diving cycles; and avoidance reactions, such as vacating an area. (Kastak, et al., 1999; Richardson, et al., 1995)

In determining behavioral reactions in marine mammals, prior studies of humpback whales have generally showed no strong reactions to acoustic pulses of approximately 150 dB (referenced to 1 μPa) resulting from large explosions 1.2 mi (1.9 km) away. It is uncertain, however, whether the whales had become habituated to the blasting activities before observations began. In another study, captive false killer whales showed no obvious reaction to small explosions producing single noise pulses of approximately 185 dB (referenced to 1 μPa). When exposed to intense 1-second tones in a netted enclosure, bottlenose dolphins began to exhibit altered behavior at levels of 178 to 193 dB, while white whales (also referred to as beluga whales) displayed altered behavior at 180 to 196 dB. The behavioral reactions, in this case, were defined as deviations from the animals' trained behaviors, which included startle or annoyance responses. (Richardson, et al., 1995; Schlundt, et al., 2000)

Exposing these animals to even higher sound levels may increase their hearing threshold to a new level, where as, at the new post-exposure threshold, any sound must be stronger than before in order to be heard. If this hearing threshold shift returns to the pre-exposure level after a period of time, the threshold shift is referred to as a TTS resulting from a recoverable loss of hearing function. TTS can be characterized by a short-term impairment in the ability for marine mammals and other fauna to communicate, navigate, forage, and detect predators. If the threshold shift does not return to the pre-exposure level, it is a PTS caused by a permanent loss of hearing function. (68 FR 17909-17920; Kastak, et al., 1999; Richardson, et al., 1995)

Single or occasional occurrences of mild TTS do not cause permanent auditory damage in terrestrial mammals, or in marine mammals. However, very prolonged exposure to sound strong enough to cause a TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals. The magnitude of TTS depends on the sound pressure level and duration of noise exposure, among other factors. For single, short-duration sound impulses, higher pressures may be tolerated before the onset of a TTS occurs, when compared to longer duration pulses or repeated sound exposures at lower pressures. (68 FR 17909-17920; Finneran, 2004; Finneran, et al., 2002; Kastak, et al., 1999; Nachtigall, et al., 2003; and Schlundt, et al., 2000)

Noise levels associated with the onset of TTS are often considered to be the level below which there is no danger of injury to animals (68 FR 17909-17920). Though only a few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals (68 FR 17909-17920), research has shown the onset of TTS (from a single underwater pulse) to occur within a range of approximately 12 to 23 pounds per square inch (psi) peak pressure, or 218 to 224 dB (referenced to 1 μPa) (Finneran, et al., 2002; Ketten, 1995). The 12-psi peak underwater pressure level has also been used by the NOAA Fisheries Service as a criterion for determining Level B acoustic harassment for all marine mammals[10], in accordance with the MMPA (69 FR 2333-2336; 69 FR 29693-29696).[11]

More recently, extensive threshold studies conducted on the white whale have shown no substantial TTS when exposed to multiple, short duration acoustic pulses at 221 dB (referenced to 1 μPa) peak pressure. At 224 dB (referenced to 1 μPa and equal to 23 psi), however, TTS did occur, resulting in a 6- to 7-dB temporary reduction in hearing ability. Similar studies of the bottlenose dolphin have shown no TTS at peak pressure levels up to 226 dB (referenced to 1 μPa and equal to 30 psi) (Finneran, et al., 2002). Both

[10] Level B acoustic harassment is defined as the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (69 FR 29693-29696).

[11] Interpreting the effects of noise on marine mammals and sea turtles depends on various parameters, including the sound exposure level and duration, the sound frequency, and the animal's hearing ability. In recent years, biological literature on marine mammals and acoustic effects has tended to use (1) peak pressure levels expressed in either psi, or dB referenced to 1 μPa; (2) the average or root-mean-square level over the duration of the sound, also expressed in dB referenced to 1 μPa; and/or (3) the sound energy flux density, which is the average rate of flow of sound energy over an appropriate time, such as the duration of the first positive pressure, expressed in dB referenced to 1 micro Pascal-squared·seconds ($\mu Pa^2 s$). Because the expected underwater noise levels from sonic booms represent single pulses that are relatively low in acoustic strength, and very short in duration (less than 250 milliseconds), peak pressure levels were used for analysis purposes.

bottlenose dolphins and white whales have been used for such studies because they have hearing ranges and sensitivities equivalent to or better than many marine mammals. Thus, these two animals may be representative of other species with broad auditory bandwidth and high sensitivity (Finneran, et al., 2000).

As for permanent hearing loss, no published data for the occurrence of PTS in marine mammals is currently available. Experiments conducted with small cetacean species—where low-level threshold shifts (less than 10 dB) occurred—did not result in PTS. Though PTS has been observed in terrestrial animals, the level of single-sound exposures must be far above the TTS threshold for any risk of permanent hearing damage. For example, studies of terrestrial animals exposed to single-noise impulses have shown that threshold shifts of up to 40 dB may be fully recoverable (i.e., with no PTS). (68 FR 17909-17920; Finneran, et al., 2000, 2002; Richardson, et al., 1995; Schlundt, et al., 2000)

Based on the above information, an acoustical pulse of 178 dB (referenced to 1 μPa) was used in this analysis to represent the lower limit for inducing behavioral reactions in marine mammals (cetaceans), while 218 to 224 dB (referenced to 1 μPa and equal to 12 to 23 psi peak underwater pressure, respectively) was used in determining when the onset of TTS might occur.[12] As for sea turtles, no specific behavioral reaction or TTS data has been identified, and the potential for effects on their hearing is still unknown. However, turtles are less sensitive with respect to hearing than mammals as a group. If peak overpressure levels are considered safe for marine mammals, then they should not pose a risk to sea turtles. (USN, 2001; Wever, 1978)

Theoretical models for sonic booms generated by a large space launch vehicle (Titan IV) have shown that peak underwater pressures are likely to be on the order of 130 to 140 dB (referenced to 1 μPa), or less than 0.0015-psi peak pressure (HKC Research, 2001), well below the 178-dB and 218-dB (12-psi peak pressure) lower limits for inducing behavioral reactions and TTS (respectively) in marine mammals. Because sonic boom underwater pressures caused by the smaller OSP launch vehicles in early flight are expected to be less than those of large space launch vehicles, like the Titan IV, the sonic booms should not result in any long-term adverse effects to marine mammals.

Like the ICBM RV simulators described earlier (Moody, 2004b), the sonic booms produced by some OSP target payloads at the terminal end of flight would be expected to generate peak underwater pressures ranging from 117 dB (referenced to 1 μPa), to a high of 176 dB (referenced to 1 μPa) near the point of impact. As a result, the peak underwater pressures produced by RV sonic booms [117 to 176 dB (referenced to 1 μPa)] would fall just below the lower limit for inducing behavioral reactions (178 dB), and well below the lower limit for TTS (218 dB). Thus, no PTS or other long-term adverse impacts on protected marine mammals are expected to occur.

These findings are more evident when considering that (1) sonic booms generated are very short in duration, lasting only a fraction of a second; (2) OSP launches would occur no more than five to six times per year; (3) launch vehicle flight paths and sub-orbital target payload impact areas would not always be the same; and (4) the probability for marine mammals to be within the sonic boom footprint out in the open ocean is reasonably low.

[12] In determining when the onset of behavioral reactions and TTS might occur in marine mammals, acoustical pulse criteria were based largely on studies with small odontocetes (toothed whales). Because comparable data for other cetacean groups [e.g., mysticetes (baleen whales)] are not available, the analysis conducted in this EA assumed that the behavioral reaction and TTS data collected for small odontocetes are applicable to other whale species.

4.1.5.2.2 Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

At the velocity of their normal descent, the non-orbital spent rocket motors would each hit the ocean surface at speeds of approximately 195 to 230 ft (59 to 79 m) per second (Tooley, et al., 2004). The expended rocket motors—each weighing up to 4,902 lb (2,224 kg) for MM systems and up to 9,431 lb (4,278 kg) for PK systems—would have considerable kinetic force. Upon impact, this transfer of energy to the ocean water would cause a shock wave (low-frequency acoustic pulse) similar to that produced by explosives.

If a portion of an OSP launch vehicle were to strike a protected marine mammal or sea turtle near the water surface, the animal would most likely be killed. In addition, the resulting underwater shock/sound wave radiating out from the impact point could potentially harm nearby animals. Recent modeling studies for MM ICBM flight tests have shown that underwater noise pulse levels would be on the order of 0.4 to 0.8 psi at a range of 164 ft (50 m) from the motor's impact point (Tooley, et al., 2004). In the water, this would feel like a "sharp push." At such distances, the resulting shock/sound wave would not be expected to cause any injuries to marine mammals or sea turtles. However, for distances that are much closer to the impact point, the shock wave might injure internal organs and tissues, or prove fatal to the animals. These findings are consistent with other studies that agree fairly closely on an approximate 240-dB (referenced to 1 µPa and equal to 145 psi) baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would occur only within several feet of the rocket motor impact points. With increasing distance from the impact point, pressure levels would decrease, as would the risk for injury to animals.

An OSP sub-orbital target payload impacting in the ocean would also result in underwater shock/sound waves, similar to that of the spent rocket motors, but with much greater force because of the target vehicle's hypersonic velocity at the time of impact. Just as for an ICBM RV simulator, the resulting underwater acoustic pulse would last only about 10 to 30 milliseconds. (Moody, 2004a; Tooley, et al., 2004)

As described earlier, behavioral reactions in marine mammals can begin to occur at pressure levels as low as 178 dB (referenced to 1 µPa), while the onset of TTS has been determined to occur at peak pressure levels of about 218 to 224 dB (referenced to 1 µPa and equal to 12 to 23 psi, respectively), depending on the species and only for occasional, short-term exposures.[13] For rocket motor impacts, underwater pressure levels capable of inducing behavioral reactions in marine mammals are not expected to occur much beyond a few hundred yards, particularly for the heavier 1st-stage motor, while pressure levels for inducing TTS would only occur within a few yards of the impact point.[14] For sub-orbital target payloads, however, these distances would be much greater.

Based on acoustic impulse data for ICBM RV simulators, minimum pressure levels for inducing behavioral reactions in marine mammals, as a result of a target payload impact, could occur within a few thousand yards of the impact point. As the distance to the impact point decreases, resulting pressure levels would increase and, thus, increase the potential for altered behavior to occur. For any marine mammals in this area, reactions might include abrupt movements, changes in surfacing, and sudden dives. These behavioral reactions, if they occur, would last for a very brief period and not result in any long-

[13] See footnote 12.

[14] For similar reasons explained in footnote 11, peak pressure levels were used in the analysis of underwater shock/sound waves generated by spent rocket motors impacting in the open ocean.

term effects. For reasons described in Section 4.1.5.2.1, it is expected that sea turtles would be less affected in terms of behavioral reactions.

As for potential TTS effects, distances from target payload impacts for when the onset of TTS might occur in marine mammals are presented in Table 4-6. As the table shows, this distance ranges from 62 to 128 ft (19 to 39 m), depending on which sound pressure level is used. Because of the higher-pressure levels generated underwater by target payload impacts, energy flux density values were also calculated and are presented in Table 4-6 for comparison purposes.[15] For this analysis, it is presumed that sea turtles would also fall within this range for TTS occurrence.

Table 4-6. Target Payload Impact Distances for the Onset of Temporary Threshold Shift (TTS) in Marine Mammals

Sound Pressure Level (SPL) (dB ref to 1 μPa)	Sound Energy Flux Density [1] (dB ref to 1 $\mu Pa^2 s$)	Equivalent Underwater Peak Pressure (psi)	Radial Distance from the Point of Impact [2] [ft (m)]	Reference for Pressure Level
218	203	12	128 (39)	69 FR 2333-2336 69 FR 29693-29696 Ketten (1995)
224	209	23	62 (19)	Finneran, et al. (2002)

Notes:
[1] Sound energy flux density values were calculated in accordance with USN (2001) and are described as: SPL + [10 x log(time in seconds)]. A conservative value of 30 milliseconds was used for the positive phase exposure duration.
[2] Radial distances were calculated in accordance with methods described in Moody (2004a).

At distances less than 62 ft (19 m) from the target payload impact point, it can be expected that marine mammals and sea turtles might suffer PTS and/or other injuries. An underwater pressure level of approximately 240 dB (referenced to 1 μPa and equal to 145 psi) is considered the baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would occur only within several feet of the target payload impact point. With increasing distance from the impact point, pressure levels would decrease, as would the risk for injury to animals. The ranges of impact distances for the onset of TTS, and for determining physical injury/death, are illustrated in Figure 4-6 for target payload impacts. As described earlier, ranges for rocket motor impacts would be much lower. Because the 218-dB (referenced to 1 μPa) level represents the lowest pressure level for when TTS might occur, it can be considered the outermost limit for potential harm to marine mammals, as well as for sea turtles.

As for the risk of injury to marine mammals and sea turtles in the open ocean, analyses conducted at the Point Mugu Sea Range off the coast of Southern California (USN, 2002) have determined that there is a very low probability for marine mammals to be killed by falling boosters, targets, or other missile debris, or from the resulting shock wave of a missile impacting the water. These studies showed the cumulative number of animals expected to be injured or killed ranged from 0.0006 for US territorial waters to 0.0016 for non-territorial waters, for all related missile operations conducted over 1 year. The probability calculations were based on the densities of marine mammals in the ocean areas where activities are

[15] By including both pressure and duration, energy flux density determines the cumulative energy over time from a noise source for its entire duration. Thus, longer sound durations generally result in higher total energy levels than similar sound pressure levels of shorter duration. In the case of a target payload impact, the resulting underwater shock/sound wave represents a single pulse of very short duration, having a maximum waveform rise time of about 30 milliseconds (Moody, 2004a).

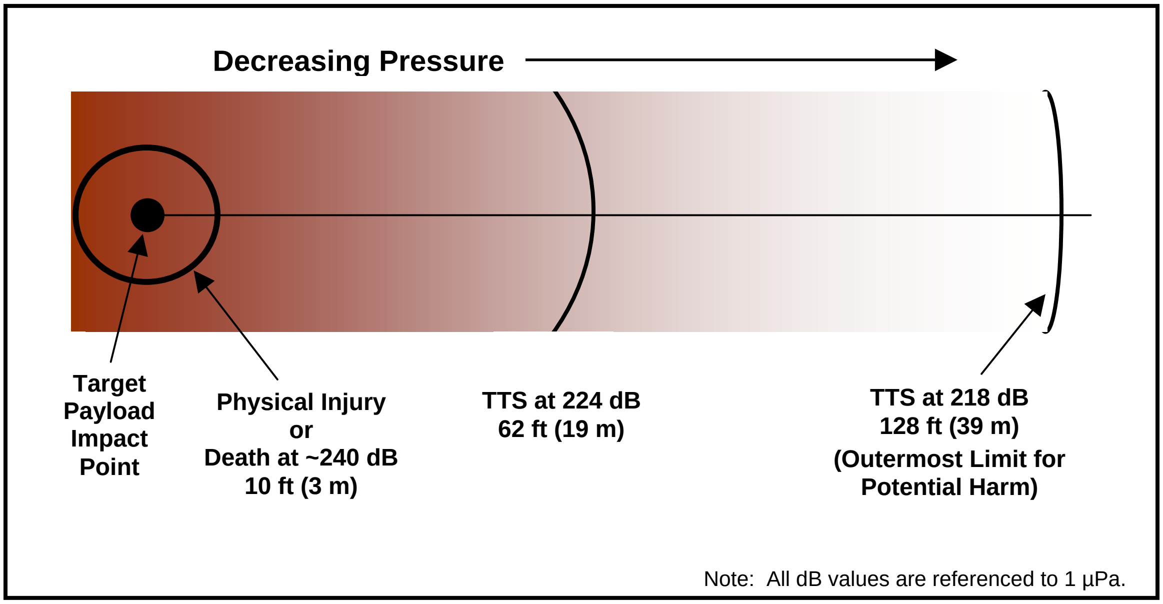


Figure 4-6. Illustration of Predicted Target Payload Impact Ranges for Underwater Shock/Sound Wave Impacts on Marine Mammals

conducted, the number of activities, and the area of influence of the activity (NAWCWPNS Point Mugu, 1998). The numbers are low enough that the probability for marine mammal injuries from falling debris can be considered negligible. Because sea turtles generally have been shown to occur in smaller numbers, when compared to marine mammals, the resulting probabilities for impacts on them would be even less.

Thus, no long-term adverse impacts on protected marine mammals and sea turtles are expected to occur, because (1) the likelihood for an animal to be located within the shock/sound wave impact zone is extremely low; (2) impact sites for each flight likely would not occur in the same areas; and (3) OSP flights would occur only five to six times per year (at most), and even fewer flights would be sub-orbital missions carrying RV simulators or other target payloads.

4.1.5.2.3 Contamination of Seawater

By the time the spent rocket motors impact in the ocean, all of the solid propellants in them would have been consumed. The residual aluminum oxide and burnt hydrocarbon coating the inside of the motor casings would not present any toxicity concerns. Though the batteries carried onboard the rocket motors and in some sub-orbital payloads would be spent (discharged) by the time they impact in the ocean, they would still contain small quantities of electrolyte material. The battery materials, along with residual amounts of hydraulic fluid and other materials used in the motor TVC systems, may mix with the seawater, causing contamination. The release of such contaminants could potentially harm marine life that comes in contact with, or ingests, toxic levels of these solutions.

NASA previously conducted a thorough evaluation of the effects of launch vehicles that are deposited in seawater. It concluded that the release of hazardous materials carried onboard rocket systems would not be significant. Materials would be rapidly diluted in the seawater and, except for the immediate vicinity of the debris, would not be found at concentrations identified as producing adverse effects (PMRF, 1998). Ocean depths in the ROI reach thousands of feet and, consequently, any impacts from hazardous materials are expected to be minimal. The area affected by the dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the minimal amount of residual materials they contain. Such components would immediately sink to the ocean bottom, out of reach of marine mammals, sea turtles, and most other marine life. Though it is possible for deep ocean, benthic species to be adversely affected by any remaining contaminants, such impacts would be very localized, occurring within a short distance to rocket debris deposited on the ocean floor. Consequently, no significant impacts to biological resources are expected from the contamination of seawater.

4.1.5.2.4 Failed or Terminated Launch

In the unlikely event of a system failure during launch, or an early termination of flight, the launch vehicle would fall to the ocean intact or as debris scattered over a large area. It is expected that the falling debris would not have a significant impact on biological resources because of the large expanse of the ocean area and the very low probability of striking a marine mammal or sea turtle.

Initiating flight termination after launch would split or vent the solid propellant motor casing, releasing pressure and terminating propellant combustion. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be dispersed over an ocean area of up to several square miles. Of particular concern is the ammonium perchlorate, which can slowly leach out of the solid propellant resin binding-agent once the propellant enters the water. However, as described in Section 4.1.1.3, it is unlikely that perchlorate concentrations would accumulate to a level of concern. The overall concentration and toxicity of dissolved solid propellant from the unexpended rocket motors, or portions of them, is expected to be negligible and without any substantial effect. Any pieces of propellant expelled from a destroyed or exploded rocket motor would sink hundreds or thousands of feet to the ocean floor. At such depths, the material would be beyond the reach of most marine life.

Any liquid propellants (e.g., hydrazine, MMH, and NTO) contained in the payload (spacecraft) and/or in the HAPS (if used) could also be released in the ocean waters on impact, assuming they are not consumed or vaporized during the destruct action. Wave action and currents would quickly dilute the liquid propellants, in addition to them being buffered or oxidized in the seawater, thus eliminating potentially toxic concentrations (see Section 4.1.1.3). Should the propellant tanks survive ocean impact intact, they would sink to great depths and settle on the ocean floor. There, they could potentially leak propellants into the water over time. As with the solid propellants, the liquid propellants would be beyond the reach of most marine life. Though it is possible for deep ocean, benthic species to be adversely affected by any remaining contaminants, such impacts would be very localized, occurring within a short distance to launch vehicle debris deposited on the ocean floor.

In summary, OSP launches would have no discernible effect on the ocean's overall physical and chemical properties. There would be minimal risk of launch vehicle components hitting or otherwise harassing marine mammals and sea turtles within the ROI. Moreover, such activities would have no discernible effect on the biological diversity of either the pelagic or benthic marine environment. Consequently, no threatened and endangered marine mammals or sea turtles are likely to be adversely affected, nor would other biological resources within the ROI be significantly impacted.

4.1.5.3 Orbital and Re-entry Debris

All OSP missions would minimize the creation of orbital debris and re-entry debris through compliance with DOD Directive 3100.10 (*Space Policy*), DOD Instruction 3100.12 (*Space Support*), and AFI 91-202 (*The US Air Force Mishap Prevention Program*).

4.1.5.3.1 Orbital Debris

The OSP orbital missions would, nonetheless, contribute to the orbital debris population. This would be in three ways: (1) through short-term solid rocket motor emissions consisting of aluminum oxide dust and larger chunks of unburned propellant, or slag; (2) from inadvertent litter such as separation devices, payload shrouds, and other expendable hardware, and longer-term environmental degradation of the upper stages from atomic oxygen and solar radiation; and (3) from the upper-stage, intact rocket motors that would go into elliptical orbits. (OTA, 1990)

Debris can collide with both active and passive satellites, damaging the active satellites and producing more debris from both. Pollution in the form of gases and particles from rocket motor exhaust may also erode and contaminate spacecraft surfaces. (OTA, 1990)

The effects of OSP mission-generated orbital debris impacts on other spacecraft would depend on the velocity, angle of impact, and mass of the debris. Impacts vary from surface pitting and erosion to significant damage, depending on system vulnerability and defensive design provisions (OSTP, 1995). The probability for OSP mission spacecraft in LEO to collide with medium- or large-size debris, over their functional lifetimes, is considered low (NRC, 1995). Moreover, OSP missions would be conducted and timed to avoid any possible impact or collision with the International Space Station and other manned missions, as part of normal operations. Accordingly, no significant impacts to the orbital debris population are expected.

To reduce the extent of orbital debris, a variety of measures would be applied to OSP orbital missions to minimize orbital debris concerns. For example, launch vehicles and spacecraft can be designed so that they are litter-free through disposal of separation devices, payload shrouds, and other expendable hardware (other than upper-stage rocket bodies) at a low enough altitude and velocity that they do not become orbital (SMC, 2002). Also, per DOD Instruction 3100.12, all on-board sources of stored or residual energy (pressurized gas, fuel, or mechanical energy) on a spacecraft, or upper stage, must be depleted, burned, vented, or made safe in order to prevent explosions and reduce the risk of debris being generated.

In accordance with DOD Directive 3100.10 and DOD Instruction 3100.12, spacecraft disposal at the end of mission life must be planned for programs involving on-orbit operations. A spacecraft, or upper stage, may be disposed of by either (1) atmospheric re-entry, (2) maneuvering away from an operational orbit regime to a storage orbit, or (3) direct retrieval. If atmospheric re-entry is planned, DOD Instruction 3100.12 requires limiting the lifetime of orbiting spacecraft to no more than 25 years after completion of the mission. All OSP orbital missions would comply with these requirements.

4.1.5.3.2 Re-entry Debris

Re-entry debris presents an extremely low risk to humans. In general, sub-millimeter size objects settle slowly through the stratosphere. Intermediate size objects (millimeter to decimeter) may melt/vaporize in or above the stratosphere. However, larger objects (decimeters and larger) may survive to the Earth's surface. Atmospheric drag will eventually pull these objects to Earth. How much depends on the materials used in the spacecraft's construction, and on size, shape, and weight of the re-entering object. For example, if the object is made of stainless steel or titanium (both with high melting temperatures), such as fuel tanks, much of this material will survive atmospheric re-entry. Objects made of aluminum (with a relatively low melting temperature), however, tend not to survive. (CORDS, 2004).

During an orbital mission, the rocket motor upper stage used for orbital injection of a mission payload would itself become an orbital object, unless the stage is deliberately de-orbited. Injection stages proposed for use in OSP missions include the solid propellant Orion-38, Orion-50XL, Star-37, Star-48, and SR73-AJ-1 motors, along with the liquid propellant HAPS. These stages lack restart capability or, in the case of the HAPS, adequate propulsive capability to be de-orbited. Instead, they would decay naturally from orbit as a result of atmospheric drag and re-enter at some essentially random time. In the course of this process, which can last days, weeks, months, or years, these stages would pose orbital risk to operational satellites (per Section 4.1.5.3.1) and re-entry risk to populations on the ground. The population at risk would be constrained only by the orbital inclination of the randomly reentering object.

Risk from re-entry is also a function of cross-sectional area of debris surviving re-entry. Because of the relatively simple construction of the injection stages intended for OSP use, the re-entry survivability of components can be conservatively estimated. The Orion-38, Orion-50XL, and SR73-AJ-1 stages are constructed largely of materials—including graphite composite and fiberglass motor casings with aluminum fixtures—incapable of surviving the extreme re-entry heating environment. Survivable materials would be limited to the motor nozzle assemblies. Since large portions of the nozzles would not survive, it is conservative to assume that these nozzles would survive intact to impact. For the SR73-AJ-1, a tungsten component is also assumed to survive. The Star-48 motor uses a titanium-alloy casing that is known to survive re-entry intact, as predicted by analysis and evidenced by recovered debris. The nozzles from Star-48 motors have not been recovered and would not be expected to survive. For the HAPS stage, survivable materials potentially include a titanium-alloy propellant tank and three steel thruster assemblies. It can be conservatively assumed that these four objects from the HAPS survive separately to surface impact. (Weaver, 2004)

Risk to populations on the ground from random re-entry of orbital debris is expressed in terms of expected casualties. DODI 3100.12 recommends that the casualty risk should not exceed 1 in 10,000 for components and structural fragments that survive re-entry. The number of expected casualties for random re-entry of the upper stages proposed for OSP missions has been estimated using the following pieces of information:

- The range of orbital inclinations available from the four installations (Vandenberg AFB, Kodiak Launch Complex, Cape Canaveral AFS, and Wallops Flight Facility) proposed for OSP missions,
- The population density within potential impact areas, as a function of orbital inclination, and
- Conservative estimates of the size and number of re-entering objects (fragments) from each of the injection stages likely to survive re-entry. (CORDs, 2004; Opiela and Matney, 2003; Weaver, 2004)

Based on the calculations, the number of expected casualties would range from approximately 0.1 to 0.6 in 10,000, with the Star-48 motor resulting in the highest risk levels. However, none of the candidate injection stages exceeded the risk guideline of no more than 1 in 10,000 expected casualties, as defined by DOD Instruction 3100.12. (Weaver, 2004)

As for orbital mission spacecraft and other payloads, the casualty risk from re-entry should be assessed once mature spacecraft design information and orbital mission requirements are adequately defined. For example, the casualty risk for re-entry debris resulting from the Experimental Satellite System-11 spacecraft launched earlier this year was calculated to be 0.55 in 10,000 events, well within conformance to the DOD guidelines (Weaver, 2005). For the future NFIRE mission, however, the preliminary casualty expectation for a random (uncontrolled) re-entry of the NFIRE spacecraft was determined to be 1.7 in 10,000, which would exceed the risk guidelines (Weaver, et al., 2004).

When the re-entry casualty expectation is determined to be greater than 1 in 10,000, the first course of action would be to modify the spacecraft design—including size, shape, and composition of components—as a means of minimizing the number of fragments that might survive re-entry, thus reducing the overall casualty risk. An alternative course of action would be to modify the spacecraft's mission to include a controlled re-entry or de-orbit into a BOA. This would involve a series of planned braking maneuvers or engine burns that would direct any surviving debris into the ocean or other unpopulated areas. However, redesign of a given spacecraft may not be technically feasible or practical, and controlled re-entry may not be possible (due to lack of propulsion or insufficient propulsion on-board). In this case, it would be up to the primary decision-maker within the agency or Service to determine whether the casualty risk is acceptable and, based on mission requirements and cost effectiveness, whether to proceed with the mission.

Because casualty risks for re-entry debris from all injection stage motors, and from all or most OSP orbital mission payloads, are expected to be within DOD guidelines, and because no casualties from re-entry debris have been reported over the last 40 years, no significant impacts from re-entry debris are expected to occur.

4.2 ENVIRONMENTAL CONSEQUENCES OF THE NO ACTION ALTERNATIVE

Under the No Action Alternative, the OSP would not be implemented. As a result, potential impacts from proposed facility modifications and construction would not occur. It is expected, however, that demolition-related actions at Vandenberg AFB would still occur, as described and analyzed in the *Final Draft Programmatic Environmental Assessment for Demolition and Abandonment of Atlas and Titan Facilities, Vandenberg Air Force Base, California* (USAF, 2005). For the demolition of Atlas and Titan Heritage program buildings and facilities, individual projects would be spread over years, thus limiting the occurrence of potential air, noise, and other environmental impacts. At both Vandenberg AFB and at Cape Canaveral AFS, hazardous materials (e.g., lead-based paint, asbestos, and PCBs) within existing buildings and facilities would continue to be managed in place until demolitions or other modifications for facility reuse can be made.

Also under the No Action Alternative, it is expected that fewer launches using ICBM assets would occur (less than the maximum of six annual launches proposed for the OSP), and they would occur at fewer locations. Some orbital and sub-orbital launches using ICBM assets would occur through existing or new NEPA analyses, separate from this EA. Thus, launch-related impacts similar to those identified in this EA would still take place at certain locations (particularly Vandenberg AFB and Kodiak Launch Complex), but not as often, and only at currently active launch sites.

Some undetermined number of small-satellite orbital missions may rely on larger, commercial launch systems (e.g., Atlas and Delta systems), though some of these can generate environmental impacts (e.g., noise and biological resource impacts) potentially more severe than those caused by proposed OSP launch systems. However, it is expected that the No Action Alternative would result in fewer launches at all sites when compared to the Proposed Action, thus, resulting in less environmental risk overall.

4.3 CUMULATIVE EFFECTS

Cumulative effects are considered those resulting from the incremental effects of an action when considering past, present, and reasonably foreseeable future actions, regardless of the agencies or parties involved. In other words, cumulative effects can result from individually minor, but collectively potentially significant, impacts occurring over the duration of the Proposed Action and within the same geographical area.

The following sections describe the potential for cumulative impacts to occur at each of the four ranges proposed for implementing the OSP.

4.3.1 VANDENBERG AIR FORCE BASE

The proposed OSP launches would be conducted in a manner very similar to that of other launch systems in use at Vandenberg AFB. Moreover, both MM and PK systems have for years been routinely launched at Vandenberg in support of the ICBM Force Development Evaluation (FDE) flight tests. Table 4-7 shows that up to six additional OSP launches per year (two PK-derived and four MM-derived launches) would cause a 26 to 55 percent increase in annual launch rates, based on available launch rate forecasts through Fiscal Year (FY) 2009, for a total average of 25.4 launches per year. Though this represents a substantial increase in launches at the base, such launch rates for the OSP are unlikely to occur every year. It is expected that launch forecasts beyond FY 2009 would be similar through completion of the OSP in 2015.

Table 4-7. Launch Rate Forecast for Vandenberg AFB, California

Launch System	Fiscal Year				
	2005	2006	2007	2008	2009
Atlas V	0	2	1	1	0
Delta II	3	3	2	2	0
Delta IV	3	0	1	0	0
Titan IV	1	0	0	0	0
Taurus	0	0	0	3	2
PK FDE	2	0	0	0	0
MM III FDE	5	5	4	4	4
BMDS	4	11	11	9	3
Space-X Falcon	1	1	0	0	0
Pegasus	1	1	2	3	2
Current Launch Rate Totals	**20**	**23**	**21**	**22**	**11**
OSP PK-Derived Launches (max)	2	2	2	2	2
OSP MM-Derived Launches (max)	4	4	4	4	4
New Launch Rate Totals (max)	**26**	**29**	**27**	**28**	**17**

Notes:
FDE = Force Development Evaluation
BMDS = Ballistic Missile Defense System
Source for current launch rates: Ellis, 2004; VAFB, 2004c

After nearly four decades of operation, all Titan system launches from SLC-4 will end this year, as will Peacekeeper ICBM flight tests from North Vandenberg. Under the new Evolved Expendable Launch Vehicle program (USAF, 1998, 2000a), the Delta IV system begins launches this year from SLC-6, while Atlas V launches from SLC-3 will begin in FY 2006.

In addition to recent changes in launch programs, the demolition of numerous older buildings and structures on base is planned over the next 10 years, as described and analyzed in the *Final Draft Programmatic Environmental Assessment for Demolition and Abandonment of Atlas and Titan Facilities, Vandenberg Air Force Base, California* (USAF, 2005).

The potential for cumulative impacts to occur at Vandenberg AFB is discussed in the following paragraphs for each affected resource.

Air Quality. Demolition and construction-related activities for the OSP, and for other projects on base, would occur at different locations, at different times over a period of several years, and generally would be short term. Because of this and the implementation of best management practices during construction, fugitive dust and other emissions would not have a significant effect on local or regional air quality, or violate air quality standards.

OSP and other rocket launches represent short-term, discrete events that would occur at different times and at different locations across Vandenberg AFB. The emissions would not accumulate because winds quickly and effectively disperse them between launches. In addition, the proposed MM- and PK-derived vehicles for OSP would generate fewer emissions, in most cases, than larger space lift systems (e.g., Atlas, Delta, and Titan) in use at the base. Consequently, no significant cumulative impacts to air quality are anticipated.

Noise. The OSP and other launch programs would be conducted from multiple locations across the base. The OSP launch vehicles would generate lower noise levels per launch, when compared to the larger space lift systems in use (e.g., Atlas, Delta, and Titan). Also, despite the relatively high increase in number of launch events, the noise generated would be very brief, would only occur a few times per year, and would not have any perceptible impact on cumulative noise metrics, such as the CNEL. Thus, implementation of the OSP at Vandenberg AFB is not expected to result in any significant cumulative impacts on noise.

Biological Resources. Demolition and construction-related activities for the OSP, and for other projects on base, would occur at different locations and at different times over a period of several years, and generally would be short term. Limited areas of vegetation would be cleared or disturbed, which would occur mostly around existing facilities.

The proposed increase in the number of launches would result in an increase in launch noise and sonic boom events, and rocket emissions released. However, OSP and other rocket launches represent short-term, discrete events that would occur at different times and at different locations across the base. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, the USAF has implemented various plans and measures to limit the extent and frequency of potential launch impacts on protected and sensitive species. In addition, monitoring of certain species during launches is conducted on a regular basis to ensure that no long-term or cumulative impacts occur. To address the short-term disturbance of threatened and endangered species from launches, the USFWS has authorized the incidental harassment of certain terrestrial and freshwater species. For the harassment of marine mammals (pinnipeds), the NOAA Fisheries Service has granted a take permit for Vandenberg AFB that covers a forecast of up to 30 launches per year. As Table 4-7 shows, the addition of six OSP launches per year (maximum) would not cause the forecast limit to be exceeded.

Though the OSP would result in an increase in the number of short-term impact events at the range, no long-term significant cumulative effects on biological resources are anticipated. Consequently, no cumulative adverse effects on threatened and endangered species or critical habitats are expected to occur.

Cultural Resources. Vandenberg AFB has an Integrated Cultural Resources Management Plan already in place for the long-term protection and management of cultural resources occurring on the base. Also, per Federal and state regulations, and agreements with the California SHPO, Vandenberg AFB personnel regularly coordinate and consult with the SHPO and Native American specialists prior to implementing new projects where historical, archaeological, or traditional resources could be affected. As part of normal procedures, workers are informed of the sensitivity of cultural resources and the mitigation measures that might be required if sites are inadvertently damaged or destroyed, and security forces regularly patrol the base to help prevent potential vandalism and looting of such resources. Because of the requirements and procedures already in place, and the limited potential for proposed OSP construction activities and launch operations to affect cultural resources on base, implementation of the OSP at Vandenberg AFB is not expected to result in any significant cumulative impacts on these resources.

Health and Safety. On Vandenberg AFB, all projects must comply with applicable standards, policies, and procedures for health and safety. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, military personnel, and contractors. Because implementation of the OSP would also comply with these same requirements, no significant cumulative impacts to health and safety are expected to occur.

Hazardous Materials and Waste Management. The cumulative generation of solid waste from OSP-related demolition and construction activities, in addition to other planned demolitions, has the potential to exceed the permitted disposal tonnage on base. Coordination of implementation schedules for these projects, and appropriate tracking of disposal tonnages, would ensure that permitted disposal amounts at the Base Landfill are not exceeded.

In addition, implementing the OSP would not introduce new hazardous materials and wastes, and only a small increase in wastes would be expected from the additional six launches per year (maximum) that might occur. Therefore, no significant cumulative impacts from the management of hazardous materials and waste are anticipated.

4.3.2 KODIAK LAUNCH COMPLEX

At Kodiak Launch Complex, the proposed OSP launches would be conducted in a manner very similar to that of other launch systems in use. Moreover, MM systems are currently launched from the Complex, and PK-like systems (e.g., Athena I) have previously been launched. Table 4-8 shows that up to six additional OSP launches per year (two PK-derived and four MM-derived launches) would cause a 100 to 200 percent increase in annual launch rates, based on available launch rate forecasts through FY 2010, for a total average of 10.3 launches per year. Though this represents a substantial increase in launches, such launch rates for the OSP are unlikely to occur every year. It is expected that launch forecasts beyond FY 2010 would be similar through completion of the OSP in 2015.

Table 4-8. Launch Rate Forecast for Kodiak Launch Complex, Alaska

Launch System	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Strategic Target System	1	0	0	0	0	0
MM II	0	3	2	2	2	1
Other	3	2	1	2	4	3
Current Launch Rate Totals	**4**	**5**	**3**	**4**	**6**	**4**
OSP PK-Derived Launches (max)	2	2	2	2	2	2
OSP MM-Derived Launches (max)	4	4	4	4	4	4
New Launch Rate Totals (max) [1]	**10**	**11**	**9**	**10**	**12**	**10**

[1] Before an annual launch rate greater than nine launches could occur in any given year, the AADC would need to seek a modification to the launch site operator license from the FAA/AST.

Source for current launch rates: AADC, 2004

Currently, the AADC is only licensed to operate the Kodiak Launch Complex for up to nine launches per year. Before any increase in the annual number of launches could occur, the AADC would need to seek a modification to the launch site operator license from the FAA/AST.

The potential for cumulative impacts to occur at Kodiak Launch Complex is discussed in the following paragraphs for each affected resource.

Air Quality. OSP and other rocket launches represent short-term, discrete events that would occur at different times of the year at Kodiak Launch Complex. The emissions would not accumulate because winds quickly and effectively disperse them between launches. Consequently, no significant cumulative impacts to air quality are anticipated.

Noise. Launch noise levels generated by OSP vehicles would not be any higher than the noise levels produced by other launch programs currently in place at Kodiak Launch Complex. Despite the relatively high increase in number of launch events, the noise generated would be very brief, would only occur a few times per year, and would not have any perceptible impact on ambient noise levels. Thus, implementation of the OSP at the Complex is not expected to result in any significant cumulative impacts on noise.

Biological Resources. The proposed increase in the number of launches would result in an increase in launch noise events and rocket emissions released. However, OSP and other rocket launches represent short-term, discrete events that would occur at different times of the year. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, the AADC has implemented various plans and measures to limit the extent and frequency of potential impacts on protected and sensitive species. In addition, pre- and post-launch surveys of certain species are conducted for each mission to ensure that no long-term or cumulative impacts occur. To better address the short-term disturbance of marine mammals from launches, the AADC has submitted a request to the NOAA Fisheries Service for a LOA to take, by harassment, small numbers of pinnipeds on Ugak Island.

Though the OSP would result in an increase in the number of short-term impact events at the range, no long-term significant cumulative effects on biological resources are anticipated. Consequently, no cumulative adverse effects on threatened and endangered species are expected to occur.

Health and Safety. On Kodiak Launch Complex, all projects must comply with applicable standards, policies, and procedures for health and safety. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, Government personnel, and contractors. Because implementation of the OSP would also comply with these same requirements, no significant cumulative impacts to health and safety are expected to occur.

Hazardous Materials and Waste Management. Implementing the OSP would not introduce new hazardous materials and wastes, and only a small increase in wastes would be expected from the additional six launches per year (maximum) that might occur. Therefore, no significant cumulative impacts from the management of hazardous materials and waste are anticipated.

4.3.3 CAPE CANAVERAL AIR FORCE STATION

The proposed OSP launches would be conducted in a manner very similar to that of other launch systems in use at Cape Canaveral AFS. Although not on the current forecast, MM systems, as well as other systems that are similar to the PK (e.g., Athena I and II), have previously been launched from the range. Table 4-9 shows that up to five additional OSP launches per year (two PK-derived and three MM-derived launches) would cause a 31 to 45 percent increase in annual launch rates, based on available launch rate

Table 4-9. Launch Rate Forecast for Cape Canaveral AFS, Florida						
Launch System	**Fiscal Year**					
	2005	**2006**	**2007**	**2008**	**2009**	**2010**
Atlas IIIB/V	4	5	4	3	6	3
Delta II/IV	9	10	7	7	7	9
Titan IV	1	0	0	0	0	0
SLBM	2	1	2	1	3	1
Current Launch Rate Totals	**16**	**16**	**13**	**11**	**16**	**13**
OSP PK-Derived Launches (max)	2	2	2	2	2	2
OSP MM-Derived Launches (max)	3	3	3	3	3	3
New Launch Rate Totals (max)	**21**	**21**	**18**	**16**	**21**	**18**

Notes:
SLBM = Submarine Launched Ballistic Missile
Source for current launch rates: PAFB, 2004

forecasts through FY 2010, for a total average of 19.2 launches per year. Though this represents a substantial increase in launches, such launch rates for the OSP are unlikely to occur every year. It is expected that launch forecasts beyond FY 2010 would be similar through completion of the OSP in 2015.

Under the new Evolved Expendable Launch Vehicle program (USAF, 1998, 2000a), the Atlas V and Delta IV systems began launching from LC-41 and LC-37, respectively, in 2002. Also, after some 45 years of operation at the Cape, the last Titan system was launched earlier this year.

LC-20 is currently being augmented with additional facilities for NASA's ATDC, which will provide resources for the research, development, demonstration, testing, and qualification of spaceport and range technologies (NASA, 2001b). Initial development of the ATDC should be completed in 2006. Conducting OSP launches from LC-20 would require sharing use of the launch complex with ATDC operations.

The potential for cumulative impacts to occur at Cape Canaveral AFS is discussed in the following paragraphs for each affected resource.

Air Quality. OSP and other rocket launches represent short-term, discrete events that would occur at different times and at different locations across Cape Canaveral AFS. The emissions would not accumulate because winds quickly and effectively disperse them between launches. In addition, the proposed MM- and PK-derived vehicles for OSP would generate fewer emissions, in most cases, than larger space lift systems (e.g., Atlas, Delta, and Titan) in use at the station. Consequently, no significant cumulative impacts to air quality are anticipated.

Noise. The OSP and other launch programs would be conducted from multiple locations across the station. The OSP launch vehicles would generate lower noise levels per launch, when compared to the larger space lift systems in use (e.g., Atlas, Delta, and Titan). Also, despite the relatively high increase in number of launch events, the noise generated would be very brief, would only occur a few times per year, and would not have any perceptible impact on ambient noise levels. Thus, implementation of the OSP at Cape Canaveral AFS is not expected to result in any significant cumulative impacts on noise.

Biological Resources. The proposed increase in the number of launches would result in an increase in launch noise events and rocket emissions released. However, OSP and other rocket launches represent short-term, discrete events that would occur at different times and at different locations across the station. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, the USAF has implemented various plans and measures to limit the extent and frequency of potential impacts on protected and sensitive species. In addition, monitoring of certain species is conducted on a regular basis to ensure that no long-term or cumulative impacts occur.

Though the OSP would result in an increase in the number of short-term impact events at the range, no long-term significant cumulative effects on biological resources are anticipated. Consequently, no cumulative adverse effects on threatened and endangered species or critical habitats are expected to occur.

Health and Safety. On Cape Canaveral AFS, all projects must comply with applicable standards, policies, and procedures for health and safety. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, military personnel, and contractors. Because implementation of the OSP would also comply with these same requirements, no significant cumulative impacts to health and safety are expected to occur.

Hazardous Materials and Waste Management. Implementing the OSP would not introduce new hazardous materials and wastes, and only a small increase in wastes would be expected from the additional five launches per year (maximum) that might occur. Therefore, no significant cumulative impacts from the management of hazardous materials and waste are anticipated.

4.3.4 WALLOPS FLIGHT FACILITY

At Wallops Flight Facility, the proposed OSP launches would be conducted in a manner similar to that of some other launch systems in use. Table 4-10 shows that up to five additional OSP launches per year (two PK-derived and three MM-derived launches) would cause an approximate 13 percent increase in annual launch rates, based on available launch rate forecasts through FY 2010, for a total average of 42.5 launches per year. Though this represents a modest increase in launches, such launch rates for the OSP are unlikely to occur every year. It is expected that launch forecasts beyond FY 2010 would be similar through completion of the OSP in 2015.

Table 4-10. Launch Rate Forecast for Wallops Flight Facility, Virginia

Launch System	Fiscal Year					
	2005	2006	2007	2008	2009	2010
Orbital Missile	1	2	1	2	1	2
Sounding Rockets (small & large)	10	10	10	10	10	10
Vandal	5	5	5	5	5	5
Drones (small & large)	20	20	20	20	20	20
Air Launched Missile	1	1	1	1	1	1
Current Launch Rate Totals	**37**	**38**	**37**	**38**	**37**	**38**
OSP PK-Derived Launches (max)	2	2	2	2	2	2
OSP MM-Derived Launches (max)	3	3	3	3	3	3
New Launch Rate Totals (max)	**42**	**43**	**42**	**43**	**42**	**43**

Source for current launch rates: Goddard Space Center, 2004

The potential for cumulative impacts to occur at Wallops Flight Facility is discussed in the following paragraphs for each affected resource.

Air Quality. OSP and other rocket launches represent short-term, discrete events that would occur at different times and at different locations on Wallops Island. The emissions would not accumulate because winds quickly and effectively disperse them between launches. Consequently, no significant cumulative impacts to air quality are anticipated.

Noise. The OSP and other launch programs would be conducted from multiple locations on Wallops Island. Also, despite the modest increase in number of launch events, the noise generated would be very brief, would only occur a few times per year, and would not have any perceptible impact on ambient noise levels. Thus, implementation of the OSP at Wallops Flight Facility is not expected to result in any significant cumulative impacts on noise.

Biological Resources. The proposed increase in the number of launches would result in an increase in launch noise events and rocket emissions released. However, OSP and other rocket launches represent short-term, discrete events that would occur at different times and at different locations on Wallops Island. Through coordination and consultations with the USFWS and the NOAA Fisheries Service, NASA has implemented various plans and measures to limit the extent and frequency of potential impacts on protected and sensitive species. In addition, monitoring of certain species is conducted on a regular basis to ensure that no long-term or cumulative impacts occur.

Though the OSP would result in an increase in the number of short-term impact events at the range, no long-term significant cumulative effects on biological resources are anticipated. Consequently, no cumulative adverse effects on threatened and endangered species or critical habitats are expected to occur.

Health and Safety. On Wallops Flight Facility, all projects must comply with applicable standards, policies, and procedures for health and safety. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, Government personnel, and contractors. Because implementation of the OSP would also comply with these same requirements, no significant cumulative impacts to health and safety are expected to occur.

Hazardous Materials and Waste Management. Implementing the OSP would not introduce new hazardous materials and wastes, and only a small increase in wastes would be expected from the additional five launches per year (maximum) that might occur. Therefore, no significant cumulative impacts from the management of hazardous materials and waste are anticipated.

4.3.5 GLOBAL ENVIRONMENT

In terms of upper atmospheric effects, rocket emissions released into the upper atmosphere would add to the overall global loading of chlorine and other gases that contribute to long-term ozone depletion. However, the amount of ozone depletion from rocket motor emissions is negligible compared to losses of ozone from other global sources. Because the rocket emissions would represent an extremely small percentage of total loading in the atmosphere, the launches would not significantly contribute to the cumulative impact on stratospheric ozone.

Potential cumulative impacts on marine life in the BOA could occur from the five to six annual OSP launches, over and above projected launches identified for the four ranges in Tables 4-7 through 4-10. Though sonic booms could lead to hearing loss in marine mammals and sea turtles, the noise levels are of very short duration and the resulting underwater peak pressures caused by the launch vehicles are expected to be well below TTS levels. There would be a slight increase in the risk for launch vehicle debris to strike marine life in the open ocean, but again, protected marine species are widely scattered and the probability of debris striking a marine mammal or sea turtle is considered very remote. The resulting shock/sound wave produced by the spent rocket motors and target payloads, when they impact in the water, could cause injury or death to animals close to the impact point, and also lead to potential temporary hearing loss in animals farther away. However, the probability for such an occurrence is very low, considering the minimal number of launches proposed annually, the relatively low population distribution of animals in the open ocean, and the small size of the ocean areas affected by each launch. Thus, no significant cumulative impacts to marine life are anticipated.

The OSP orbital missions would contribute to the growing amount of orbital debris, increasing the likelihood of additional orbital collisions to occur. However, with a maximum of six launches a year over a 10-year period, and considering that not all launches would be in support of orbital missions, the additive, incremental consequences would be small. Moreover, spacecraft would be designed to minimize the generation of additional debris (see Section 4.1.5.3), and the lifetime of orbiting spacecraft would be limited to no more than 25 years following mission completion. As for re-entry debris, the OSP orbital missions could potentially increase the risk to populations on the ground, but this depends largely on orbital inclinations of individual missions, spacecraft design, and specific mission requirements. Consideration would be given to spacecraft design as a means of minimizing the possibility of debris surviving atmospheric re-entry. In addition, each mission would have a debris re-entry survivability analysis conducted to determine a casualty expectation. Individual missions would be planned with the objective to not exceed DOD guidelines for casualty risk (no greater than 1 in 10,000).

Consequently, no significant cumulative impacts to the global environment are anticipated.

4.4 SUMMARY OF ENVIRONMENTAL MONITORING AND MANAGEMENT ACTIONS

Throughout Chapters 2.0, 3.0, and 4.0 of this EA, various management controls and engineering systems for all locations affected are described. Required by Federal, state, DOD, and agency-specific environmental and safety regulations, these measures are implemented through normal operating procedures.

Though no significant or other major impacts are expected to result from implementation of the Proposed Action, some specific environmental monitoring and management activities have been identified to minimize the level of impacts that might occur at some locations or in some environmental settings. These are summarized below and include the relevant sections of the EA where they are further described.

Vandenberg AFB

- To minimize PM emissions during demolition and construction activities, standard dust reduction measures would be implemented, including application of water to excavated and graded areas, minimizing vehicle speeds on exposed earth, covering soil stockpiled for more than 2 days, and establishing a vegetative or other groundcover following completion of project activities. (Section 4.1.1.1)

- To ensure that no protected or sensitive plant or animal species are harmed, biological surveys of vegetated areas would be completed prior to the start of any clearing or other ground disturbances. (Section 4.1.1.3)

- To avoid impacts to protected migratory birds and bat species, surveys of buildings to be demolished or modified would be conducted several months prior to project implementation, before start of the nesting season. Methods to discourage roosting and the initiation of nests would be implemented prior to demolition and facility modifications. Existing migratory bird nests, however, would not be removed or destroyed unless determined by a qualified biologist to be inactive. (Section 4.1.1.3)

- To minimize potential impacts on marine mammal species (pinnipeds), particularly from launch noise and sonic booms, launch operations would comply with all acoustical and biological monitoring requirements, and other measures, identified in the NOAA Fisheries Service programmatic take permit and current LOA. (Section 4.1.1.3)

- To minimize the potential for impacts on California least terns and Western snowy plovers, missions conducted at the TP-01 and ABRES launch sites, would avoid night and low-light launches to the extent possible. (Section 4.1.1.3)

- All aircraft must maintain a slant distance of not less than 1,900 ft (579 m) from least tern and snowy plover nesting areas (from March 1 through September 30), and a year-round minimum 500 ft (152 m) slant distance from all identified snowy plover habitat areas on base. (Section 4.1.1.3)

- To minimize potential long-term impacts on Federally threatened and endangered species, monitoring requirements would be conducted for OSP launches, in accordance with the existing USFWS biological opinions and base monitoring plans that are currently in effect for each of the proposed OSP launch sites at Vandenberg AFB. (Section 4.1.1.3)

- Any OSP-related activities that would occur within 200 ft (61 m) of a known archaeological site would require boundary testing to ensure that portions of the site are not inadvertently disturbed. Any archaeological site or potential site where tested boundaries are within 100 ft (30 m) of the project would require monitoring by archaeologists and/or Native American specialists during earth disturbing activities. The OSP would be responsible for implementation of any required avoidance of archaeological sites, or other mitigation measures, assigned to the project as a condition of approval for the activity by Vandenberg AFB and the California SHPO. (Section 4.1.1.4)

- Contractors and base support personnel would be informed of the sensitivity of cultural resources and the mitigation measures that might be required if sites are inadvertently damaged or destroyed. (Section 4.1.1.4)

- In the unlikely event that previously undocumented cultural resource items are discovered during the execution of the proposed action, work would be temporarily suspended within 100 ft (30 m) of the discovered item and the base archaeologist would immediately be notified. Work would not resume until after the site has been secured and properly evaluated. (Section 4.1.1.4)

- Modifications and related demolition activities to some buildings and facilities might require surveys for asbestos, lead-based paint, and PCB ballasts if such information is not already available. Any removal of hazardous materials from the buildings and facilities would require containerizing and proper disposal at the Base Landfill or at other permitted facilities located off base. (Section 4.1.1.6)

- The cumulative solid waste generation of demolition debris and materials from actions associated with the OSP, in addition to other planned demolitions, has the potential to exceed the permitted disposal tonnage on base. Coordination of implementation schedules for these projects, and appropriate tracking of disposal tonnages, would ensure that permitted disposal amounts at the Base Landfill are not exceeded. (Section 4.3.1)

Kodiak Launch Complex

- The AADC will continue to document bald eagle behaviors at the nesting site on Narrow Cape immediately down range from the launch pad. This effort will include documentation of nest site fidelity before and after each launch. (Section 4.1.2.3)

- In support of each mission, pre- and post-launch water samples are taken from several stream sites within a few miles of the launch pad to monitor water quality. A reference stream located well outside of the ROI is also sampled. (Section 4.1.2.3)

- Until the NOAA Fisheries Service authorizes an incidental take permit for the harassment of marine mammals, the AADC will continue to conduct acoustical and biological monitoring for Steller sea lions on Ugak Island for each launch. (Section 4.1.2.3)

- In anticipation of the USFWS final ruling on designating threatened status for the northern sea otter, the AADC has already begun informal “conferencing” with the Service to determine whether any protective measures for the species will be necessary during launches. For each launch campaign, the AADC is also conducting aerial surveys to document any changes in sea otter numbers (Section 4.1.2.3)

- The rain and artesian water that collects in the flame trench at Launch Pad 1 would be periodically tested for water chemistry prior to discharge. The effects of the wastewater discharge would be monitored, as is currently done following other missions. (Section 4.1.2.5)

Cape Canaveral AFS

- To prevent facility lighting from potentially affecting the behavior and movement of adult sea turtles and hatchlings at night, the existing LMP for LC-20 or LC-46 would be modified for proposed OSP activities in accordance with 45th SWI 32-7001. Once specific OSP activities and lighting requirements are identified, consultations with the USFWS would be reinitiated to amend the LMP for approval. (Section 4.1.3.3)

- Modifications to some of the existing facilities might require lead-based paint and asbestos surveys if such information is not already available. Additionally for LC-20, coatings on the launch stand and the exterior of nearby facilities may require sampling for any remaining PCBs. Any removal of hazardous materials from the facilities would require containerizing and proper disposal at permitted facilities. (Section 4.1.3.5)

Wallops Flight Facility

- To help minimize launch noise-related concerns in the local community, the public would be notified in advance of launch dates. (Section 4.1.4.2)

- NASA will continue to conduct biological monitoring of piping plovers on the south end of Wallops Island during the first three launches from launch pad 0-B. Depending on the results of the surveys, and at the discretion of the USFWS, additional years of monitoring might be required. (Section 4.1.4.3)

- The piping plover critical habitat areas on Wallops Island will continue to be closed to vehicle and human traffic during the nesting season. Additionally, helicopters and other aircraft must adhere to a 1,000-ft (305-m) no-fly zone horizontally and vertically from the plover habitat areas during the nesting season. (Section 4.1.4.3)

Global Environment

- To reduce the extent of orbital debris, and eventual re-entry debris safety concerns, a variety of measures would be applied to OSP orbital missions. For example, launch vehicles and spacecraft can be designed so that they are litter-free through disposal of separation devices, payload shrouds, and other expendable hardware (other than upper-stage rocket bodies) at a low enough altitude and velocity that they do not become orbital. Additionally, all on-board sources of stored or residual energy (pressurized gas, fuel, or mechanical energy) on a spacecraft or upper stage can be depleted, burned, or vented as a means of preventing explosions and reducing the risk of debris being generated. (Section 4.1.5.3)

- As a means of minimizing or avoiding risks to populations on the ground, the spacecraft for some OSP orbital missions would be maneuvered into a controlled re-entry or de-orbit into the ocean or an unpopulated area. (Section 4.1.5.3)

- The design and composition of OSP mission spacecraft would be taken into consideration as a means of minimizing the number of components that might survive atmospheric re-entry. For example, use of components made with high melting point materials (e.g., stainless steel and titanium), that can survive re-entry, would be minimized (Section 4.1.5.3)

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6.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED

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The following is a list of agencies, organizations, and officials that were sent a copy of the Draft EA/FONSI for the Orbital/Sub-Orbital Program. A separate list is provided for each affected range.

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